ENGINEERING NEWS

A JOURNAL OF CIVIL, MECHANICAL, MINING AND ELECTRICAL ENGINEERING

Vol. 60. No. 24. 220 Broadway, New York, December 10, 1908.

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A RAIL AND WATER FREIGHT TERMINAL AT BRISTOL, ENGLAND: GREAT WESTERN RY.

The extension of railway terminal facilities in English cities is usually a difficult and costly work, owing to the congested conditions and the high land values. An interesting work of this kind has been carried out at Bristol, where the Great Western Ry. has built a branch line along the docks to a new local freight station and storage warehouse. Fig. 1 shows this new freight terminal and its proximity to the Bristol Cathedral. The oldest parts of this ancient structure date back to 1140, but the present structure was commenced in the early part of the 14th century. It has been restored and extended at various times.

The site of the new terminal was originally part of the cathedral property and consisted of marshy meadows extending to the river. It still retains its name of "Canon's Marsh" (referring to some religious dignitary). When acquired by the railway company it included some small industrial plants and a tract of low-lying ground used for the storage of timber. It has water on two sides, being at an angle in the harbor, but is separated from the city's dock property and the water front by a road. A masonry wharf or quay wall forms the water front, and has sheds and municipal warehouses. Vessels lie at the wharf, which has 21 ft. of water alongside, and their cargoes can be delivered to or from the dock sheds or directly to or from railway cars, the harbor railway connecting with the new railway freight yard. In Fig. 1, the distant building with the row of gable roofs is one of the dock sheds. Beyond it (and across the harbor) is one of the new grain warehouses and a municipal warehouse for the tobacco trade.

This part of the river was long ago converted into a continuous dock or "floating harbor" some miles in length. A new channel was made for the river, with lock connections at either end of the old channel. A feeder canal was also built to make good the loss of water due to locking vessels in and out of the harbor.

The area occupied by the terminal is of approximately triangular shape (at an angle of the harbor). The entrance is at the apex, and the sides have lengths of approximately 800 ft., 1,000 ft. and 1,200 ft. The site was raised to the required elevation by filling, and the buildings have foundations of concrete footings on groups of concrete piles. There are 28 tracks in all, some in pairs and others in groups of three. Of these, 24 are in the yard; two of these extend beyond it and across the road to a connection with the tracks of the harbor railway along the docks. The freight station has four tracks; one of these is a single stub track. The others extend beyond the building and unite in a single tail track for convenience in switching cars.

The general arrangement of the freight station is shown in Fig. 2. The freight house is 540 × 135 ft. For 270 ft. at one end it is a two-story building, with tracks and platforms on the first floor and a storage or warehouse floor above. The remainder of the length has only the freight shed. Adjacent to the warehouse portion is a two-story office building 40 × 28 ft. The two-story buildings are of reinforced concrete construction on the Hennebique system. The warehouse has five longitudinal rows of columns, spaced 27 ft. apart longitudinally and forming transverse spans of from 22 ft. 3 ins. to 46 ft., as shown in the plan. The lower floor has a wall upon one side only, the other side being open to give teams convenient access to the freight platform. This floor is 16 ft. high from the platforms. The upper floor is 10 ft. high and has a flat concrete roof. A cross section of the lower portion is shown in Fig. 3.

The other end of the freight station, 270 × 133 ft., has steel roof trusses of triangular form. These are in two spans of 64 ft. 9 ins. and 68 ft. 3 ins. The trusses are 22 ft. 6 ins. apart, and their inner ends are supported alternately on steel columns (45 ft. apart) and on a line of lattice girders between the tops of these columns. The outer ends of the shorter trusses are carried by brackets on the concrete wall. The longer trusses are supported by columns and girders so placed as to leave a cantilever span of 22 ft. 3 ins. over the platform and driveway. This arrangement is shown in the cross section Fig. 4. The trusses have their lower chords 15 ft. 5 ins. clear above the rails. Between the trusses are lattice girder purlins from 6 ft. to 7 ft. apart. There is a low monitor roof with louvre openings in the sides. The roof covering is of corrugated galvanized iron, with wide skylights having the Rendle system of glazing. The wind screen at the end is also of corrugated iron. Figs. 5 and 6 are views of the concrete and steel portions of the freight station.

THE NEW CANON'S-MARSH FREIGHT TERMINAL OF THE GREAT WESTERN RY. AT BRISTOL, ENGLAND.
(At the left is Bristol Cathedral, which dates from 1310 and contains some portions of an abbey which was completed in 1148.)

The station has two 20-ft. platforms and four tracks, as already noted. The platforms are of solid construction, as is usual in English practice. Each has two 18-in. brick walls on concrete foundations, with earth filling between, and a 6-in. deck of concrete. In the concrete are embedded transverse nailing sleepers, 3 ft. apart; their upper faces are 1½ ins. above the concrete so as to form an air space under the 2½-in. planking. The edges of the platform are protected by steel angles 5 × 3½ ins. (which are of a rounded section instead of forming a sharp angle). Three rows of 9-in. oak plank are laid next to the angle coping on the track side, while on the team side is a ⅜-in. steel plate 15 ins. wide. These provide for the extra wear at the sides of the platform. The brick wall on the track side is corbelled out, to give the legal space between the rail and the wall. The wall on the driveway side has a bench to support a 6 × 12-in. timber wheel guard. This is faced with a ⅜-in. plate and bolted through the wall. This wall also has a 6 × 12 in. creosoted coping

timber, anchored into the wall by bolts and having the coping angle fitted to its edge.

On each platform are four electric revolving jib or pillar cranes, and each crane has a weighing scale within its swing. Thus freight can be handled between cars and wagons, and also placed upon the scales. There are also three electric elevators running from the platforms to the upper floor of the warehouse. The surface of the platforms is 3 ft. 4 ins. above the rails and

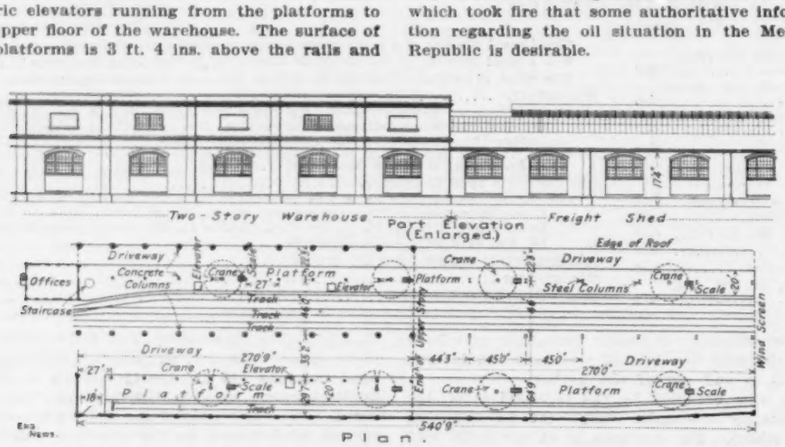

FIG. 2. PLAN AND ELEVATION OF FREIGHT STATION AT CANON'S-MARSH, BRISTOL, ENGLAND.

2 ft. 8 ins. above the team driveways. These driveways are paved with granite blocks 10 × 5 × 5 ins., laid on a 2-in. bed of sand.

The freight yard is paved with 10 ins. of coarse broken stone and 4-in. of ordinary macadam stone. It is completely surrounded by a high fence, so that there is no trespassing.

RAILWAY APPROACH AND DRAWBRIDGES.

The railway line to the new terminal included some difficult work, being laid out along a crowded water front. It is largely on the surface, though important roads are carried over it. It is protected by an "unclimable" fence, with gates at all grade crossings. For part of the distance, where the tracks are close to a new quay wall, the tracks are laid with longitudinal timbers instead of cross ties. In addition to giving access to the new terminal, the line affords direct railway communication to the gas works and some large manufacturing plants, which were formerly dependent upon team and wagon service.

There are two drawbridges. One of these is a double-track double-deck truss bridge 202 ft. long, crossing the "new cut" or river diversion channel of the river Avon. The other is a double-track plate-girder swing bridge crossing a 62-ft. lock. This is a bobtail bridge, with arms 88 ft. 10 ins. and 45 ft. 3 ins. in length. The girders of this bridge are from 7 ft. to 8 ft. deep, 27 ft. 3 ins. apart, with 24-in. plate-girder floor beams resting on the bottom flanges. These are 12 ft. apart. Between the floor-beams are four lines of plate-girder stringers capped with longitudinal timbers for the rails, which are of bridge section. Between these timbers is a deck of planking, laid longitudinally. A 4½-ft. sidewalk is carried by cantilever brackets outside of one of the main girders. The bridge revolves on a hemispherical ball and socket bearing, the ball being attached to a heavy fish-bellied box-girder floor beam 3½ ft. deep. The tail end of the bridge is fitted with rollers which ride on a curved rail. The bridge is operated by hydraulic cylinders whose piston rods carry sheaves for a chain which is led around a semi-circular shallow drum or swinging circle on the land side of the box girder. Hydraulic power is also used in the pivot to raise the bridge from its seat.

The works were all designed and carried out under the direction of Mr. James C. Inglis, General Manager and Consulting Engineer of the Great Western Ry.; Mr. W. Y. Armstrong was engineer of new works. Mr. M. Strachan, of Cardiff, was contractor for the works; the contractor for the building was Mr. Robertson, of Bristol.

MEXICAN PETROLEUM: THE TUXPAN OIL WELL FIRE.

By HENRY FLOY,* M. Am. Inst. E. E.

There have appeared in the American newspapers during the past few months such startling but rather vague accounts of oil discoveries in Mexico with widespread destruction of property and life resulting from one of the oil wells which took fire that some authoritative information regarding the oil situation in the Mexican Republic is desirable.

Oil indications exist in Lower California, on Lake Chapala near Guadalajara, in many places along the gulf coast and even in the suburbs of Mexico City itself. On the Isthmus of Tehuantepec, at San Cristobal, located on a branch of the Coatzacoalcos River about 40 miles from the Gulf of Mexico, oil of good quality is being produced in a commercial way. This oil has a paraffine base affording the usual commercial products and is quite distinct in character from

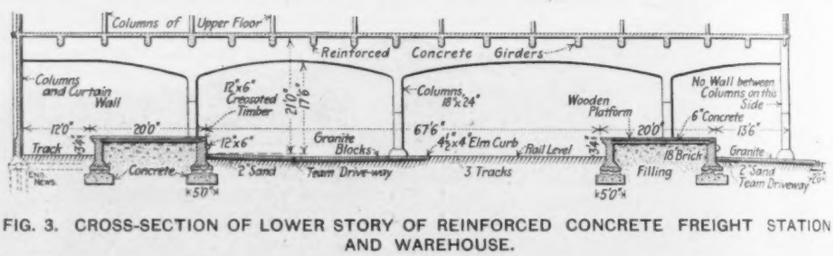

FIG. 3. CROSS-SECTION OF LOWER STORY OF REINFORCED CONCRETE FREIGHT STATION AND WAREHOUSE.

the oil that has recently been discovered further north in the vicinity of Tampico. A pipe line has been built from San Cristobal, 20 miles to Minatitlan, where a refinery has been erected, which is at present treating in the vicinity of 5,000 bbls. of crude oil per day. Much of the refined product is being shipped from Coatzacoalcos in tank steamers to European ports. The oil supply at San Cristobal is controlled by S. Pearson & Son, Ltd., of London, which firm has entered the oil business in Mexico and England in competition with the Standard Oil Co. and its reputed representatives in Mexico, the Waters-Pierce Co.

For several years large quantities of heavy asphaltic oil have been produced at Ebano, located almost 35 miles due west of Tampico on the Mexican Central R. R., the principal well being said to be 3,700 ft. deep and originally flowing freely, but now being pumped. At present, the Ebano wells have an output of between 11,000 and 12,000 bbls. per day, of which 6,000 bbls. are sold to the Mexican Central R. R. under contract, for supplying the oil-burning locomotives with which this road is equipping its lines as rapidly as the increase of fuel oil supply will permit. The Waters-Pierce Co. have erected a refinery at Ebano, which consumes most of the balance of the oil produced at this point, a limited amount being shipped to Tampico and there being used mainly under the boilers of the electric light company.

About 65 miles south of Tampico on a laguna or lake, which runs parallel to the shore of the Gulf of Mexico, being separated from the latter by a strip of land a few miles wide, certain interests understood to be backed by S. Pearson & Co. have for some time been sinking wells with the expectation of finding oil in what is known as the San Geronimo field near Tuxpan. Up to last July, four wells have been put down, two of which it is claimed struck oil at a depth of about 2,000 ft., and were safely capped. One well, known as No. 3, had been driven to a depth reported as 1,837 ft. when unexpectedly, on July 4, 1908, oil was struck and spouted with great force and volume. Fire in the boiler used in connection with the drill was immediately extinguished and the clinkers were covered with earth; but the pressure of the oil forced its way up through crevices, which developed in the earth and thus came in contact with the hot cinders and started the fire, which has become memorable throughout the civilized world. The well drilled was 8 ins. in diameter and through this the oil was discharged with terrific force and velocity, so great in fact that for a considerable distance above the ground the oil had no chance to burn. At the height of about 40 ft., as the spray was thrown off, the fire began and continued upward to a point, at times, from 1,500 to 1,600 ft. in the air. The column of oil itself arose to a height of 425 ft. The column of flame was about 180 ft. in diameter and so brilliant that one observer claimed that at a distance of 17 miles, at night, he was able to read a copy of the Philadelphia Saturday Evening Post without great difficulty.

The figures given above relating to height were determined by triangulation methods and are undoubtedly correct for the time the measurements were made. The estimated discharge of the well at the time being 77,000 bbls. per 24 hours, although when the well first started it is claimed the output was 100,000 lbs. per 24 hours. Owing to the abrading effect of the discharge, the well opening was rapidly enlarged; as time went on salt water in increasingly larger amounts came out mingled with the oil, which has increased until it is now estimated the outflow of salt water exceeds 10,000,000 bbls. per 24 hours. The geyser effect has entirely disappeared, the opening in the earth having enlarged to several hundred feet in diameter, the surrounding earth having been weakened, so that it caved in, and a spring several acres in area now marks the original site of the geyser. As the salt water has continued to increase in amount, its temperature has gradually increased, at the rate of about one degree a day, until the temperature is now about 175° F. This has resulted in volatilizing the lighter oils so that large quantities of more or less poisonous and obnox-

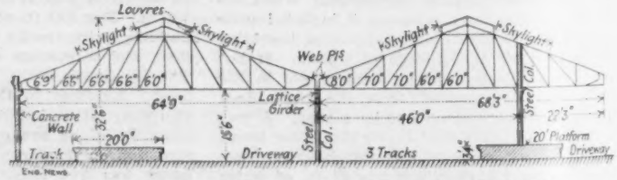

FIG. 4. CROSS-SECTION OF STEEL FREIGHT SHED.

*Consulting Engineer, 165 Broadway, New York City.

lous gases are given off which are painful to the eye and produce insensibility if breathed for any considerable length of time. At present the discharge is more or less intermittent, being in the nature of surges with the pressure only sufficient to cause the discharge to rise a few feet above the level of the river, which has been formed. As yet no practical means have been

FIG. 5. INTERIOR OF LOWER STORY OF FREIGHT STATION AND WAREHOUSE (REINFORCED CONCRETE CONSTRUCTION.)

evolved for separating the comparatively small proportion of heavy oils and asphalt from the salt water, so that the well is practically useless.

The fire started on July 4, 1908, and burned without intermission for about three months when the mouth of the pit became sufficiently gorged with sand, earth and water to choke and prevent any further discharge until all the oil exposed had burned out. During the time of the fire large amounts of money and many ineffective efforts were expended in the attempt to stop the fire. Several plans were tried, none of which, however, proved successful. The last method undertaken was the erection of metal shields, as close to the fire as practicable, behind which it was planned to locate men controlling lines of hose, connected with several large centrifugal pumps, and throwing sand and water on to the fire. The pumps had been installed and arrangements about completed for making this attempt at subduing the flames when the debris choked the discharge for a sufficient length of time for the oil to burn out.

The reports of the damage done to property, quadrupeds and human beings by the vapors from the burning well have been grossly exaggerated. While a number of workmen had been overcome, all but two were promptly resuscitated. A number of animals, particularly the mules used in building dykes to control the oil, have been killed. As for vessels in the Tampico harbor or ships at sea becoming discolored, no authentic reports have been received. The pungent odor of the fumes have been noticeable several miles from the well but no particular damage has resulted therefrom.

At the request of the people interested, the Mexican Government sent several companies of soldiers, including a part of the Engineering Corps, to the scene of the fire with the hope of suggesting methods of and assisting in extinguishing the flames and saving the waste of oil. After spending several weeks on the field without having accomplished anything particularly effective, and the fire having gone out, the soldiers, to the number of 660 (including 120 women and 40 children) returned, reaching Tampico on Nov. 4, where they took steamer to Vera Cruz.

The Waters-Pierce Co., at a reputed cost of $2,500,000 and some other interests, have secured the rights on land adjoining that where the oil fire took place, and are now drilling for oil. Tampico has developed into something of an American "boom" town, there being a large number of prospectors for oil and promoters of oil companies making their headquarters there and working in the surrounding territory. Prospecting is going on not only south of Tampico, but also north and inland, so that in the course of a few months it will be determined whether Tampico is to become the centre of one of the greatest oil fields yet developed or whether the supply available is really limited and the strike near Tuxpan merely a fortunate—or perhaps it is better to say unfortunate—striking of an oil pocket.

The oil thus far discovered around Tampico is a heavy, thick, black oil containing about 50% asphaltum and while fairly good as a fuel oil is nothing like as valuable for refining purposes as the Pennsylvania or Oklahoma oil found in this country. It is impracticable to handle Mexican oil if its temperature is much reduced. The tanks of the locomotives using oil for fuel as well as the tank cars of the Mexican Central R. R. used for transportation are equipped with steam pipes for heating the oil in order to make it flow. Moreover, air pressure is generally used to supplement the work of the steam.

The present prices of oil at Ebano for the most favored customer is said to be 50 cts. per bbl. and about $1 per bbl. to the Tampico customers. It is a noteworthy fact that although so much oil has been discovered near Tampico and doubtless millions of barrels were consumed in the oil well fire, at present it is impracticable to purchase any oil whatever at Tampico. How much discoveries of large quantities of oil near Tampico will benefit the fuel users in the interior of the country is an open question. The central portion of Mexico is a plateau from 7,000 to 8,000 ft. above sea level. The Mexican Central R. R., from Tampico to San Luis Potosi and to Monterey, has to climb some very steep and tortuous grades so severe that it takes two 200,000-lb. locomotives, for example, to push 12 freight cars up the 30-mile grade between Tampico and Cardenas at the rate of 7 to 8 mi. per hr. This, of course, means high freight rates on everything delivered on top of the plateau. The present rates on oil in tank car load lots from Tampico to San Luis Potosi, is $1.11 (U. S. currency) per bbl. If we assume that oil will be delivered f. o. b. cars Tampico at 50 cts. per bbl., and as it takes about 3½ bbls. of oil to equal one ton of coal, the equivalent value of oil delivered at San Luis Potosi will be found to be $5.63 compared with a ton of coal, which at present costs from $6.50 to $7 in San Luis Potosi. From San Luis Potosi oil can be distributed north, west and south; but at present freight rates, its cost at the City of Mexico would probably be prohibitive. It may be argued that the rates on such an important commodity as oil will be reduced. But owing to the high cost of handling, the necessity for special cars which must be taken back empty, and owing to the fact that freight rates in general, including those on coal, have recently been advanced (although coal is at present as much of a necessity to Mexico as oil ever will be) it would seem as if the prospects for lower rates were not encouraging. With regard to piping the oil, great difficulty is likely to be encountered on account of the thickness and heaviness of the oil itself. Along the coast where oil can be distributed in tank steamers and for the foreign market, Mexican oil will doubtless be available if found in large quantities.

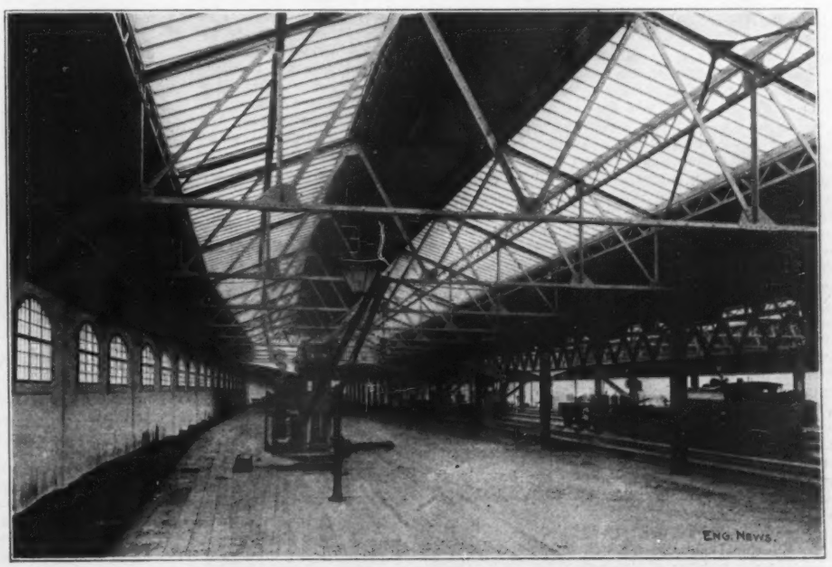

FIG. 6. INTERIOR OF FREIGHT SHED.

THE PRESENT STATUS OF MILITARY AERONAUTICS.*

By GEORGE O. SQUIER, Major, Signal Corps, U. S. A.

It is a matter of first significance that the American Society of Mechanical Engineers, composed of a body of highly trained and serious minded men, should be considering in annual meeting assembled the subject of aerial navigation. Five years ago such a subject could scarcely have had a place on the list of professional papers on your program. The present period will ever be memorable in the history of the world for the first public demonstrations of the practicability of mechanical flight. In fact, at the present moment a resistless wave of enthusiasm and endeavor, sweeping away every prejudice, is passing over the entire civilized world, fixing the attention of all classes upon the problem of flight. France, Germany and England are in a state of frenzied interest in this subject, and each period of a single month sees some new step accomplished in the march of progress. The Universal Highway is at last to be made available for the uses of mankind, with its consequent influence upon our modes of life and thought.

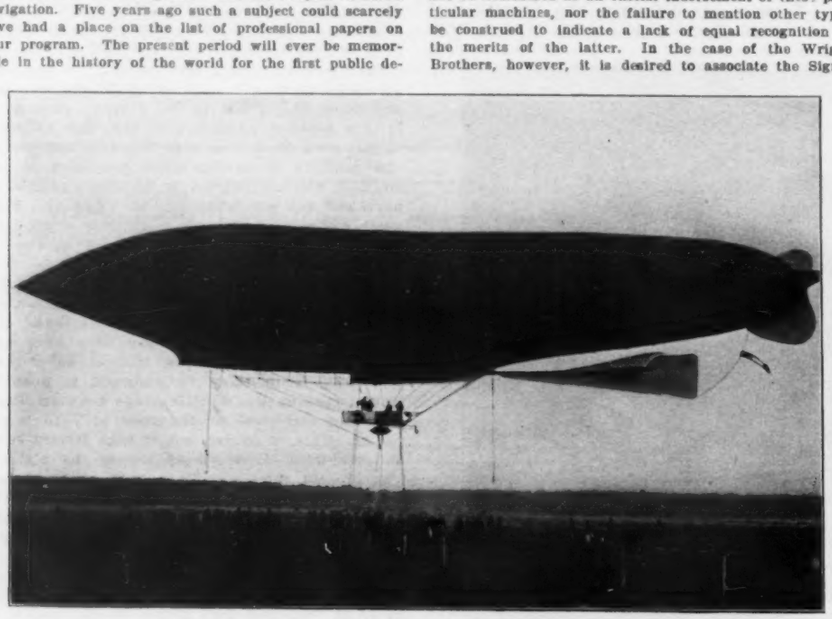

FIG. 1. FRENCH DIRIGIBLE BALLOON "LA PATRIE."

The subject of war balloons and their accessories pertains by law to the Signal Corps of the Army. On Dec. 23, 1907, the Signal Corps of the Army issued a public advertisement and specification calling for bids for furnishing the Government with a heavier-than-air flying machine.† The conditions of this specification require that the Government be furnished with a heavier-than-air flying machine capable of carrying one passenger besides the aviator, and it must remain in the air on an endurance test for a period of one hour without landing, and must also be subjected to a speed test over a measured course of more than five miles, against and with the wind, attaining a minimum speed of 36 miles per hour. The machine must, in addition, carry fuel for a continuous flight of not less than 125 miles. In preparing this specification, it was purposely sought to leave the bidder perfectly free in the methods to be employed, and he was not restricted as to type or design. At the time this specification was issued eleven months ago, the conditions were publicly regarded as being unusually severe and far beyond the state of the art at that time. That these conditions were justified has been subsequently proved, as is now well known.

It was believed that the acceptance of each of the bids submitted instead of but one of them would serve as an additional stimulus to develop practical aviation in the United States, and at the same time serve to supply the War Department with machines needed in military service. This dual object,—to advance a new art of interest to the nation as a whole, and to secure necessary equipment for the military establishment,—has been in the past and is at present the policy of the Signal Corps of the Army.

The result of issuing this specification, as well as a similar one for supplying a small dirigible balloon for the preliminary training of the men of the Signal Corps, was an awakening of interest in this subject throughout the country to such an extent that the Signal Office continues to receive daily a large number of letters, plans, and models, proposing manifold schemes for navigating the air. The Aeronautical Division of the Office of the Chief Signal Officer of the Army was organized on July 1, 1907, and the Aeronautical Board of the Signal Corps was appointed in July of the current year for conducting tests of dirigible balloons and aeroplanes under existing contracts.

It should be stated that the mention of particular types of dirigible balloons and aeroplanes in this paper must not be considered as an official indorsement of these particular machines, nor the failure to mention other types be construed to indicate a lack of equal recognition of the merits of the latter. In the case of the Wright Brothers, however, it is desired to associate the Signal Corps of the Army publicly and officially with the present universal recognition of their work in advancing the Science and Art of Aviation. These results have been due to the persistence, daring, and intelligence of these American gentlemen, to whom the whole world is now paying homage. It will ever be recorded that the classic series of public demonstrations first made by Orville Wright at the Government testing grounds at Fort Myer, Va., in Sept., 1908, and by Wilbur Wright at Le Mans, France, made a profound impression throughout the world, and kindled especially the patriotic spirit of the American people.

There are two general classes of vehicles of the air, (a) those which depend for their support upon the buoyancy of some gas lighter than air, and (b) those which depend for such support upon the dynamic reaction of the air itself. These classes are designated as

(a) Lighter-than-air types: Free balloons, dirigible balloons or airships.

(b) Heavier-than-air types: Aeroplanes, orthopters, helicopters, etc.

It should be remarked, however, that these two general classes exhibit a growing tendency to overlap each other. For example, the latest dirigible balloons are partly operated by means of aeroplane surfaces, and are also often balanced so as to be slightly heavier than the air in which they move, employing the propeller thrust and rudder surfaces to control the altitude.

Aerostation.

Captive and free balloons, with the necessary apparatus and devices for operating the same, have been for many years considered an essential part of the military establishment of every first-class power. They played a conspicuous part in the siege of Paris, and were often valuable in our own Civil War. The construction and operation of aerostats are too well understood to need further attention here.

SUCCESSFUL MILITARY DIRIGIBLE BALLOONS.

FRANCE.

Two types of dirigible balloons have been used in the French Army; first the "Patrie," and second the "Ville de Paris." The "Patrie" was developed by Julliot, an engineer employed by the Lebaudy Brothers at their sugar refinery in Paris. A history of his work beginning in 1896 is fully given in "La Conquête de l' Air."

THE PATRIE.—The "Patrie," the th[illegible] of its type, was first operated in 1906. The gas bag [illegible] the first balloon was built by Surcouf at Billancourt, [illegible] The mechanical part was built at the Lebaudy Sug[illegible]efinery. Since then the gas bags have been built at t[illegible]baudy balloon shed at Moisson, near Paris, under th[illegible]ection of their aeronaut, Juchmès. The gas bag of [illegible] "Patrie" was 197 ft. long with a maximum diamet[illegible]33 ft. 9 ins., situated about 2/5 of the length from [illegible]front; volume 111,250 cu. ft.; length approximately [illegible]meters. This relation, together with the cigar shape, [illegible] in accordance with the plans of Col. Renard's dirigib[illegible]ilt and operated in France in 1884; the same gen[illegible]ciples and proportions being found in the "Ville de P[illegible]

The first Lebaudy airship was pointed [illegible] the rear. This is generally admitted to be the proper s[illegible] for the least resistance, but to maintain stability it [illegible] found necessary to put a horizontal and vertical pl[illegible]here, so that it had to be made an ellipsoid of revol[illegible] to give attachment for these planes.

The ballonet for air had a capacity of [illegible]65 cu. ft. or about 1/5 of the total volume. This is [illegible]ulated to permit reaching a height of about one mile [illegible]d to be able to return to the earth, keeping the gas bag always rigid. To descend from a height of one mile, gas would be released by the valve, then air pumped into the ballonet to keep the gas bag rigid, these two operations being carried on alternately. On reaching the ground from the height of one mile the air would be at the middle of the lower part of the gas bag and would not entirely fill the ballonet. To prevent the air from rolling from one end to the other when the airship pitches, thus producing instability, the ballonet was divided into three compartments by impermeable cloth partitions. Numerous small holes were pierced in these partitions through which the air finally reached the two end compartments.

In Sept., 1907, the "Patrie" was enlarged by 17,690 cu. ft. by the addition of a cylindrical section at the maximum diameter, increasing the length, but not the maximum diameter.

The gas bag is cut in panels; the material is a rubber cloth made by the Continental Tire Company at Hanover, Germany. It consists of four layers arranged as follows:

	Weight, oz. per sq. yd.
a—Outer layer of cotton cloth covered with lead chromate	2.5
b—Layer of vulcanized rubber	2.5
c—Layer of cotton cloth	2.5
d—Inner layer of vulcanized rubber	2.21
Total weight	9.71

A strip of this cloth one foot wide tears at a tension of about 934 lbs. A pressure of about 1 in. of water can be maintained in the gas bag without danger. The lead chromate on the outside is to prevent the entrance of the actinic rays of the sun which would cause the rubber to deteriorate. The heavy layer of rubber is to prevent the leaking of the gas. The inner layer of rubber is merely to prevent deterioration of the cloth by impurities in the gas. This material has the warp of the two layers of cotton cloth running in the same direction and is called straight thread. The material in the ballonet weighs only about 7¾ ozs. per sq. yd., and has a strength of about 336 lbs. per running ft. When the "Patrie" was enlarged in September, 1907, the specifications for the material allowed a maximum weight of 10 ozs. per sq. yd., a minimum strength of 907 lbs. per running ft., and a loss of 5.1 cu. ins. of hydrogen per sq. yd. in 24 hours at a pressure of 1.18 ins. of water. Bands of cloth are pasted over the seams inside and out with a solution of rubber to prevent leaking through the stitches.

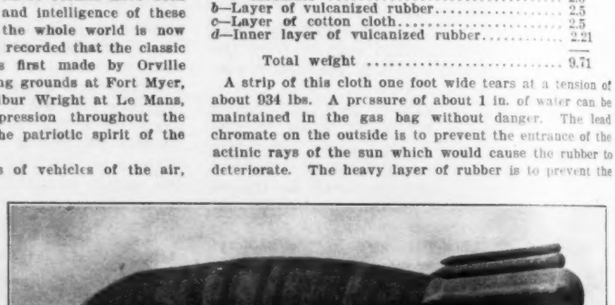

FIG. 2. FRENCH DIRIGIBLE BALLOON "LA VILLE DE PARIS."

Suspension.—One of the characteristics of the "Patrie" is the "short" suspension. The weight of the car is distributed over only about 70 ft. of the length of the gas bag. To do this, an elliptical shaped frame of nickel steel tubes is attached to the bottom of the gas bag. Steel cables run from this down to the car. A small

*Presented at the New York meeting of the American Society of Mechanical Engineers, Dec. 1-4. Printed in the December issue of the "Journal" of the Society.

†[This was reprinted in Engineering News, Jan. 2, 1908.]

hemp net is attached to the gas bag by means of short wooden cross pieces or toggles which are let into holes in a strong canvas band which is sewed directly on the gas bag. The metal frame, or platform, is attached to this net by means of toggles, so that it can be quickly removed in dismounting the airship for transportation. The frame can also be taken apart. Twenty-eight steel cables about 0.2 in. in diameter run from the frame down to the car, and are arranged in triangles. Due to the impossibility of deforming a triangle, rigidity is maintained between the car and gas bag.

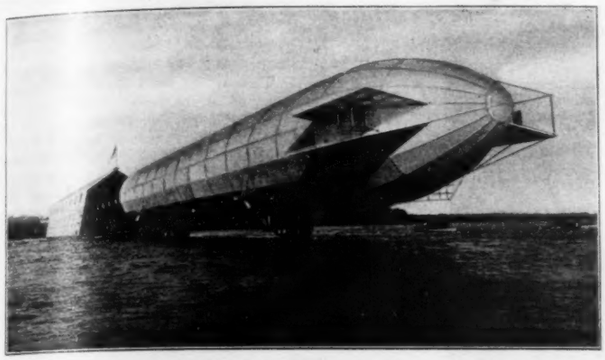

FIG. 3. GERMAN DIRIGIBLE BALLOON "ZEPPELIN" WITH FLOATING HANGER.

The objection to the "short" suspension of the "Patrie" is the deformation of the gas bag. A distinct curve can be seen in the middle.

The Car.—The car is made of nickel steel tubes (12% nickel). The car is boat-shaped, about 16 ft. long, about 5 ft. wide, and 2½ ft. high. About 11 ft. separate the car from the gas bag. To prevent any chance of the fire from the engine communicating with the hydrogen, the steel framework under the gas bag is covered with a non-combustible material.

The pilot stands at the front of the car, the engine is in the middle, the engineer at the rear. Provision is made for mounting a telephotographic apparatus, and for a 100-candle-power acetylene searchlight. A strong pyramidal structure of steel is built under the car, pointing rearward. In landing the point comes to the ground first and this protects the car, and especially the propellers, from being damaged. The car is covered to reduce air resistance. It is so low, however, that part of the equipment and most of the bodies of those inside are exposed, so that the total resistance of the car is large.

The Motor.—The first Lebaudy had a 40-HP. Daimler-Mercedes benzine motor. The "Patrie" was driven by a 60 to 70-HP. 4-cylinder Panhard and Levassor benzine motor, making 1,000 r.p.m.

The Propellers.—There are two steel propellers 8½ ft. in diameter (two blades each) placed at each side of the engine, thus giving the shortest and most economical transmission. To avoid any tendency to twist the car, the propellers turn in opposite directions. They make 1,000 to 1,200 r.p.m.

The gasolene tank is placed under the car inside the pyramidal frame. The gasolene is forced up to the motor by air compression. The exhaust is under the rear of the car pointing down and is covered with a metal gauze to prevent flames coming out. The fan which drives the air into the ballonet is run by the motor, but a dynamo is also provided so that the fan can always be kept running even if the motor stops. This is very essential as the pressure must be maintained inside the gas bag so that the latter will remain rigid and keep its form. There are five valves in all, part automatic and part both automatic and also controlled from the car with cords. The valves in the ballonet open automatically at less pressure than the gas valves, so that when the gas expands all the air is driven out of the ballonet before there is any loss of gas. The ballonet valves open at a pressure of about 0.78 in. of water, the gas valves at about 2 ins.

Stability.—Vertical stability is maintained by means of fixed horizontal planes. One having a surface of 150 sq. ft. is attached at the rear of the gas bag, and due to its distance from the center of gravity is very efficient. The elliptical frame attached under the gas bag has an area of 1,055 sq. ft. but due to its proximity to the center of gravity, has little effect on the stability. Just behind the elliptical frame is an arrangement similar to the feathering of an arrow. It consists of a horizontal plane of 150 sq. ft., and a vertical plane of 113 sq. ft. To maintain horizontal stability, that is, to enable the airship to move forward in a straight line without veering to the sides, fixed vertical planes are used. One runs from the center to the rear of the elliptical frame and has an area of 108 sq. ft.

In addition to the vertical surface of 113 sq. ft. at the rear of the elliptical frame, there is a fixed plane of 150 sq. ft. at the rear of the gas bag. To fasten the two perpendicular planes at the rear of the gas bag, cloth flaps are sewed directly on the gas bag. Nickel steel tubes are placed in the flaps which are then laced over the tubes. With these tubes as a base, a light tube and wire framework is attached and waterproof cloth laced on this framework. Additional braces run from one surface to the other and from each surface to the gas bag. The rudder is at the rear under the gas bag. It has about 150 sq. ft. and is balanced.

A movable horizontal plane near the center of gravity, above the car, is used to produce rising or descending motion, or to prevent an involuntary rising or falling of the airship due to expansion or contraction of the gas or to other causes. After the adoption of this movable horizontal plane, the loss of gas and ballast was reduced to a minimum. Ballast is carried in 10 and 20-lb. sand bags. A pipe runs through the bottom of the car from which the ballast is thrown.

There are two long guide ropes, one attached at the front of the elliptical frame and the other on the car. On landing, the one in front is seized first so as to hold the airship with the head to the wind. The motor may then be stopped and the descent made by pulling down on both guide ropes. A heavy rope, 22 ft. long, weighing 110 lbs. is attached on the end of a 164-ft. guide rope. This can be dropped out on landing to prevent coming to the ground too rapidly. The equipment of the car includes a "siren," speaking trumpet, carrier pigeons, iron pins and a rope for anchoring the airship, reserve supply of fuel and water, and fire extinguisher.

After being enlarged in September, 1907, the "Patrie" made a number of long trips at an altitude of 2,500 to 3,000 ft. In November, 1907, she went from Paris to Verdun, near the German frontier, a distance of about 175 miles, in about 7 hours, carrying four persons. This trip was made in a light wind blowing from the northeast. Her course was east, so that the wind was unfavorable. On Friday, Nov. 29, 1907, during a flight near Verdun, the motor stopped, due to difficulty with the carburetter. The airship drifted with the wind to a village about 10 miles away where she was safely landed. The carburetter was repaired on the 30th. Soon after, a strong wind came up and tore loose some of the iron pickets with which it was anchored. This allowed the airship to swing broadside to the wind; it then tilted over on the side far enough to let some of the ballast bags fall out. The 150 or 200 soldiers who were holding the ropes were pulled along the ground until directed by the officer in charge to let go. After being released, it rose and was carried by the wind across the north of France, the English Channel, and into the north of Ireland. It struck the earth there, breaking off one of the propellers and then drifted out to sea.

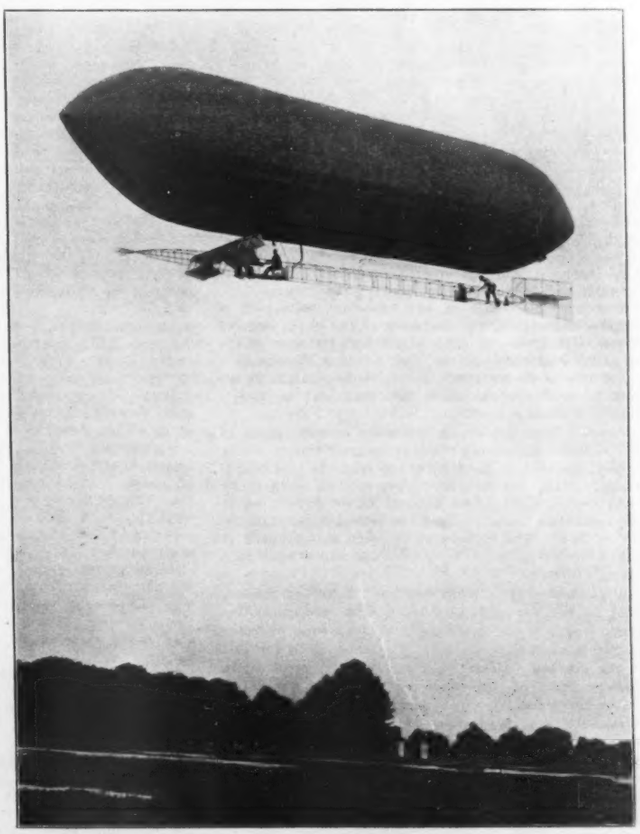

FIG. 4. U. S. A. SIGNAL CORPS' "DIRIGIBLE NO. 1," IN FLIGHT, FORT MYER, VA., AUGUST, 1908.

THE REPUBLIQUE.—This is the latest of the French military dirigible balloons, and differs but slightly from its predecessor, the "Patrie." The volume has been increased by about 2,000 cu. ft. The length has been reduced to 200 ft. and the maximum diameter increased to 35½ ft. The shape of the gas bag accounts for the 2,000 additional cubic feet of volume. The motor and propellers are as in the "Patrie." The total lifting capacity is 9,000 lbs., of which 2,700 lbs. are available for passengers, fuel, ballast, instruments, etc. Its best performance was a 125-mile flight made in 6½ hours against an unfavorable wind.

The material for the gas bag of the new airship was furnished by the Continental Tire Company. It is made up as follows:

	Weight oz. per sq. yd.
Outer yellow cotton layer	3.25
Layer of vulcanized rubber	3.25
Layer of cotton cloth	3.25
Inner layer of rubber	0.73
Total weight	10.48

It is interesting to note the changes which this type has undergone since the first one was built. The "Jaune," constructed in 1902-03, was pointed at the rear and had no stability plane there; later it was rounded off at the rear and a fixed horizontal plane attached. Finally a fixed vertical plane was added. The gas bag has been increased in capacity from 80,670 cu. ft. to about 131,000 cu. ft. The manufacturers have been able to increase the strength of the material of which the gas bag is made, without materially increasing the weight. The rudder has been altered somewhat in form. It was first pivoted on its front edge, but later on a vertical axis, somewhat to the rear of this edge. With the increase in size, has come an increase in carrying capacity and consequently a greater speed and more widely extended field of action.

THE VILLE DE PARIS.—This airship was constructed for Mr. Deutsch de la Meurthe, of Paris, who has done a great deal to encourage aerial navigation. The first "Ville de Paris" was built in 1902, on plans drawn by Tatin, a French aeronautical engineer. It was not a success. Its successor was built in 1906, on plans of Surcouf, an aeronautical engineer and balloon builder. The gas bag was built at his works in Billancourt, the mechanical part at the Voisin shop, also in Billancourt. The plans are based on those of Col. Renard's airship, the "France," built in 1884, and the "Ville de Paris" resembles the older airship in many particulars. In September, 1907, Mr. Deutsch offered the use of his airship to the French Government. The offer was accepted, but delivery was not to be made except in case of war or emergency. When the "Patrie" was lost in November, 1907, the military authorities immediately took over the Deutsch airship.

Gas Bag.—The gas bag is 200 ft. long for a maximum diameter of 34½ ft., giving a length of about 6 diameters, as in the "France" and the "Patrie." Volume 112,847

cu. ft. maximum diameter at about ⅝ of the distance from the front, approximately, as in the "Patrie." The middle section is cylindrical with conical sections in front and rear. At the extreme rear is a cylindrical section with eight smaller cylinders attached to it. The ballonet has a volume of 21,192 cu. ft., or about 1/5 of the whole volume, the same proportion found in the "Patrie." The ballonet is divided into three compartments from front to rear. The division walls are of

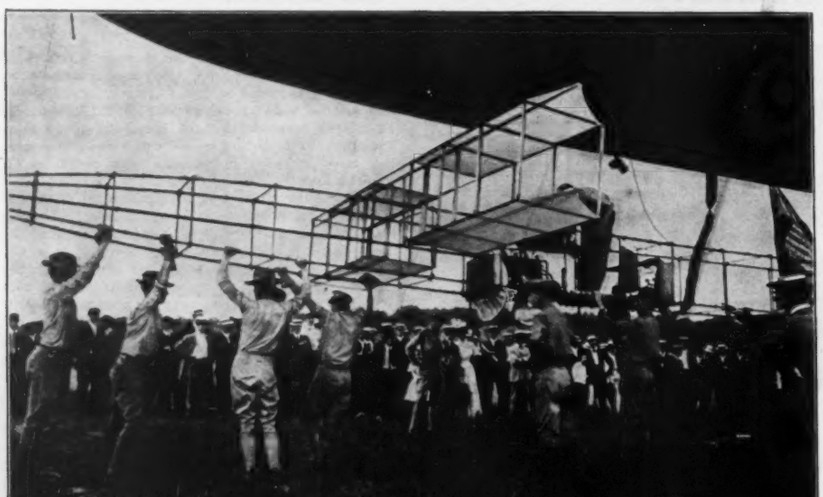

FIG. 5. U. S. A. SIGNAL CORPS' "DIRIGIBLE NO. 1," SHOWING DETAILS OF FRONT MANOEUVERING PLANES.

permeable cloth, and are not fastened to the bottom so that when the middle compartment fills with air, and the ballonet rises, the division walls are lifted up from the bottom of the gas bag, and there is free communication between the three compartments. The gas bag is made up of a series of strips perpendicular to a meridian line. These strips run around the bag, their ends meeting on the under meridian. This is known as the "brachistode" method of cutting out the material, and has the advantage of bringing the seams parallel to the line of greatest tension. They are therefore more likely to remain tight and not allow the escape of gas. The disadvantage lies in the fact that there is a loss of 33⅓% of material in cutting. The material was furnished by the Continental Tire Company, and has approximately the same tensile strength and weight as that used in the "Patrie." It differs from the other in one important feature—it is diagonal-thread, that is, the warp of the outer layer of cotton cloth makes an angle of 45° with the warp of the inner layer of cotton cloth. The result is to localize a rip or tear in the material. A tear in the straight thread material will continue along the warp, or the weave, until it reaches a seam.

Valves.—There are five in all, made of steel, about 14 ins. in diameter; one on the top connected to the car by a cord, operated by hand only; two near the rear underneath. These are automatic, but can be operated by hand from the car. Two ballonet valves directly under the middle are automatic and are also operated from the car by hand. The ballonet valves open automatically at a pressure of ⅜ in. of water, the gas valves open at a higher pressure.

Suspension.—This airship has the "long" suspension. That is, the weight is distributed along practically the entire length of the gas bag. A doubled band of heavy canvas is sewn with six rows of stitches along the side of the gas bag. Hemp ropes running into steel cables transmit most of the weight of the car to these two canvas bands and thus to the gas bag. On both sides and below these first bands are two more. Lines run from these to points half way between the gas bag and the car, then radiate from these points to different points of attachment on the car. This gives the triangular or non-deformable system of suspension, which is necessary in order to have the car and gas bag rigidly attached to each other. With this "long" suspension, the "Ville de Paris" does not have the deformation so noticeable in the gas bag of the "Patrie."

The Car.—This is in the form of a trestle. It is built of wood with aluminum joints and 0.12 in. wire tension members. It is 115 ft. long, nearly 7 ft. high at the middle, and a little over 5½ ft. wide at the middle. It weighs 660 lbs. and is considered unnecessarily large and heavy. The engine and engineer are well to the front, the aeronaut with steering wheels is about at the center of gravity.

Motor.—The motor is a 70 to 75-HP. "Argus," and is exceptionally heavy.

Propeller.—The propeller is placed at the front end of the car. It thus has the advantage of working in undisturbed air; the disadvantage is the long transmission and difficulty in attaching the propeller rigidly. It has two blades and is 19.68 ft. long with a pitch of 26.24 ft. The blades are of cedar with a steel arm. The propeller makes 250 r.p.m. when the engine is making 900 revs. (maximum speed). Its great diameter and width compensate for its small speed.

Stability.—This is maintained entirely by the cylinders at the rear. Counting the larger one to which the smaller ones are attached, there are five, arranged side by side corresponding to the horizontal planes of the "Patrie," and five vertical ones corresponding to the "Patrie's" vertical planes. The volume of the small cylinders is so calculated that the gas in them is just sufficient to lift their weight, so they neither increase nor decrease the ascensional force of the whole. The horizontal projection of these cylinders is 1,076 sq. ft. The center of this projection is 72 ft. from the center of gravity of the gas. The great objection to this method of obtaining stability, is the air resistance due to these cylinders, and consequent loss of speed. The stability of the "Ville de Paris" in a vertical plane is said to be superior to that of the "Patrie," due to the fact that the stability planes of the latter did not always remain rigid. The independent velocity of the "Ville de Paris" probably never exceeded 25 mi. per hr.

The Rudder.—The rudder has a double surface of 150 sq. ft. placed at the rear end of the car, 72 ft. from the center of gravity. It is not balanced, but is inclined slightly to the rear so that its weight would make it point directly to the rear if the steering gear should break. Two pairs of movable horizontal planes, one at the rear of the car having 43 sq. ft., and one at the center of gravity (as on the "Patrie") having 86 sq. ft. serve to drive the airship up or down without losing gas or ballast.

Guide Ropes.—A 400-ft. guide rope is attached at the front end of the car. A 230-ft. guide rope is attached to the car at the center of gravity.

About thirty men are required to manoeuver the "Ville de Paris" on the ground. The pilot has three steering wheels, one for the rudder and two for the movable horizontal planes. The instruments used are an aneroid barometer, a registering barometer giving heights up to 1,600 ft. and a gage which can be connected either with the gas bag or ballonet by turning a valve. A double column of water is also connected to the tube to act as a check on the gage. Due to the vibration of the car caused by the motor, these instruments are suspended by rubber attachments. Even with this arrangement, it is necessary to steady the aneroid barometer with the hand in order to read it. The vibration prevents the use of the statoscope.

ENGLAND.

MILITARY DIRIGIBLE NO. 1.—The gas bag of this airship was built about five years ago by Col. Templar, formerly in command of the aeronautical establishment at Aldershot. His successor, Col. Capper, built the mechanical part during the spring and summer of 1907, with the assistance of Mr. S. F. Cody, a mechanical engineer. It was operated by Col. Capper as pilot, with Mr. Cody in charge of the engine. Several ascents were made at Aldershot. In October, 1907, they made a trip from Aldershot to London, a distance of about 40 miles, landing at the Crystal Palace. For several days the rain and wind prevented attempting the return journey. On Oct. 10 a strong wind threatened to carry away the airship, so the gas bag was cut open by the sergeant in charge.

Gas Bag.—This is made of eight layers of gold beater's skin. It is cylindrical in shape with spherical ends. Volume 84,768 cu. ft.; length 111½ ft.; maximum diameter, 31½ ft. The elongation therefore is only about 3½. There is no ballonet, but due to the toughness of the gold beater's skin, a much higher pressure can safely be maintained than in gas bags of rubber cloth. Without a ballonet, however, it would not be safe to rise to the heights reached by the "Patrie."

Valves.—The valves are made of aluminum and are about 12 ins. in diameter.

Suspension.—In this airship they have succeeded in obtaining a "long" suspension with a short boat-shaped car, a combination very much to be desired, as it distributes the weight over the entire length of the gas bag and gives the best form of car for purposes of observation and for maneuvering on the ground. To obtain this combination they have had to construct a very heavy steel framework which cuts down materially the carrying capacity, and moreover, this framework adds greatly to the air resistance. This is the only airship in Europe having a network to support the car. In addition, four silk bands are passed over the gas bag and wires run from their extremities down to the steel frame. This steel frame is in two tiers; the upper is rectangular in cross-section and supports the rudder and planes; the lower part is triangular in cross-section and supports the car. The joints are aluminum.

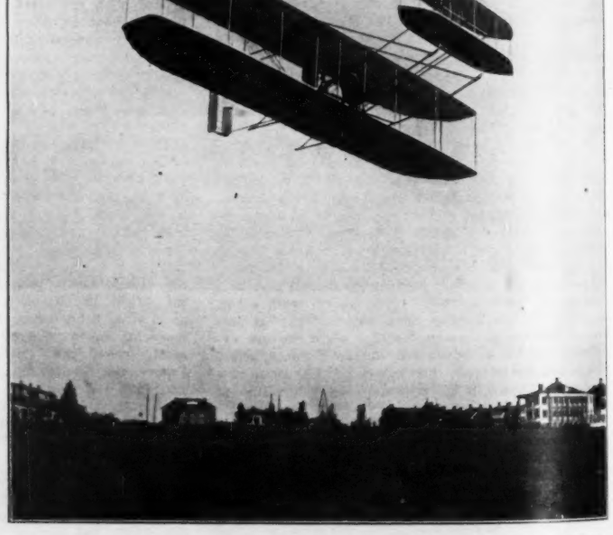

FIG. 6. WRIGHT BROTHERS' AEROPLANE, FORT MYER, VA., SEPT. 9, 1908.

The Car.—This is of steel and is about 30 ft. long. To reduce air resistance, the car is covered with cloth.

Motor.—A 40 to 50-HP. 8-cylinder Antoinette motor is used. It is set up on top of the car. The benzine tanks

are supported above in the framework. Gravity feed is used.

Propellers.—There are two propellers, one on each side, with two blades each, as in the "Patrie." They are made of aluminum, 10 ft. in diameter, and make 700 r.p.m. The transmission is by belt.

Stability.—This is maintained by means of planes. At the extreme rear is a large fixed horizontal plane. In front of this is a pair of hinged horizontal planes. Under this is the hexagonal shaped rudder. It is balanced. Two pairs of movable horizontal planes, 8 ft. x 4 ft., each placed at the front serve to guide the airship up and down, as in the "Patrie" and "Ville de Paris." These planes have additional inclined surfaces which are intended to increase the stability in a vertical plane. All these planes, both fixed and movable, are constructed like kites, of silk stretched on bamboo frames. The guide rope is 150 ft. long. Speed attained, about 16 mi. per hr. This airship with a few improvements added has been in operation the past few months. The steel framework connecting the gas bag to the car, is now entirely covered with canvas, which must reduce the resistance of the air very materially. The canvas covering, enclosing the entire bag, serves as a reinforcement to the latter and at the same time gives attachment to the suspension underneath. It is reported that a speed of 20 mi. per hr. has been attained with the reconstructed airship.

A pyramidal construction similar to that on the "Patrie" has been built under the center of the car to protect the car and propellers on landing. A single movable horizontal plane placed at the front end of the car and operated by the pilot, controls the vertical motion.

GERMANY.

Three different types of airships are being developed in Germany. The "Gross" is the design of Major Von Gross, who commands the Balloon Battalion at Tegel, near Berlin. The "Parseval" is being developed by Major Von Parseval, a retired German officer, and the "Zeppelin" is the design of Count Zeppelin, also a retired officer of the German Army.

THE GROSS.—The first airship of this type made its first ascension on July 23, 1907. The mechanical part was built at Siemen's Electrical Works in Berlin; the gas bag by the Riedinger firm in Augsburg.

Gas Bag.—The gas bag is made of rubber cloth furnished by the Continental Tire Company similar to that used in the "Ville de Paris." It is diagonal-thread, but there is no inner layer of rubber, as they do not fear damage from impurities in the hydrogen gas. Length, 131¼ ft.; maximum diameter, about 39½ ft.; volume 63,576 cu. ft.; the elongation is about 3½. The form is cylindrical with spherical cones at the ends, the whole being symmetrical.

Suspension.—The suspension is practically the same as that of the "Patrie." A steel and aluminum frame is attached to the lower part of the gas bag, and the car is suspended on this by steel cables. The objection to this system is even more apparent in the "Gross" than in the "Patrie." A marked dip along the upper meridian of the gas bag shows plainly the deformation.

The Car.—The car is boat-shaped like that of the "Patrie." It is suspended 13 ft. below the gas bag.

Motor.—The motor is a 24-HP. 4-cylinder "Daimler-Mercedes."

Propellers.—There are two propellers 8.2 ft. in diameter, each having two blades. They are placed one on each side, but well up under the gas bag near the center of resistance. The transmission is by belt. The propellers make 800 r.p.m.

Stability.—The same system, with planes, is used in the "Gross" as in the "Patrie," but it is not nearly so well developed. At the rear of the rigid frame attached to the gas bag, are two fixed horizontal planes, one on each side. A fixed vertical plane runs down from between these horizontal planes, and is terminated at the rear by the rudder. A fixed horizontal plane is attached on the rear of the gas bag as in the "Patrie." The method of attachment is the same, but the plane is put on before inflation in the Gross airship, afterwards in the "Patrie." The stability of the Gross airship in a vertical plane is reported to be very good, but it is said to veer considerably in attempting to steer a straight course.

The many points of resemblance between this dirigible and the Lebaudy type are worthy of notice. The suspension or means of maintaining stability, and the disposition for driving are in general the same. As first built, the "Gross" had a volume of 14,128 cu. ft. less than at present, and there was no horizontal plane at the rear of the gas bag. Its maximum speed is probably 15 mi. per hr. As a result of his experiments of 1907, Major Von Gross has this year produced a perfected airship built on the same lines as his first, but with greatly increased volume and dimensions. The latest one has a volume of 176,000 cu. ft., is driven by two 75-HP. Daimler motors and has a speed of 27 mi. per hr.

On Sept. 11 of this year, the Gross airship left Berlin at 10.25 p. m., carrying four passengers, and returned the next day at 11.30 a. m., having covered 176 miles in the period of a little over 13 hours. This is the longest trip, both in point of time and distance ever made by any airship returning to the starting point.

THE PARSEVAL.—The Parseval airship is owned and controlled by the Society for the Study of Motor Balloons. This organization, composed of capitalists, was formed practically at the command of the Emperor, who is very much interested in aerial navigation. The Society has a capital of 1,000,000 marks, owns the Parseval patents and is ready to construct airships of the Von Parseval type. The present airship was constructed by the Riedinger firm at Augsburg, and is operated from the balloon-house of this Society at Tegel, adjoining the military balloon house.

The gas bag is similar in construction to that of the "Drachen" balloon, used by the army for captive work. Volume, 113,000 cu. ft.; length, 190 ft.; maximum diameter, 30½ ft. It is cylindrical in shape, rounded at the front end and pointed at the rear. The material was furnished by the Continental Tire Company. It is diagonal-thread, weighing about 11.2 ozs. per sq. yd. and having a strength of about 940 lbs. per running foot. Its inner surface is covered with a layer of rubber.

Ballonets.—There are two ballonets, one at each end, each having a capacity of 10,596 cu. ft. The material in the ballonet weighs about 8¼ ozs. per sq. yd., the cotton layers being lighter than in the material for the gas bag. Air is pumped into the rear ballonet before leaving the ground, so that the airship operates with the front end inclined upward. The air striking underneath, exerts an upward pressure, as on an aeroplane, and thus adds to its lifting capacity. Air is pumped into the ballonets from a fan operated by the motor. A complex valve just under the middle of the gas bag, enables the engineer to drive air into either, or both ballonets. The valves also act automatically and release air from the ballonets at a pressure of about 0.9 in. of water.

In the middle of the top of the gas bag, is a valve for releasing the gas. It can be operated from the car, and opens automatically at a pressure of about 2 ins. of water. Near the two ends and on opposite sides, are two rip strips controlled from the car by cords.

Suspension.—The suspension is one of the characteristics of the airship, and is protected by patents. The car has four trolleys, two on each side, which run on two steel cables. The car can run backwards and forwards on these cables, thus changing its position with relation to the gas bag. This is called "loose" suspension. Its object is to allow the car to take up, automatically, variations in thrust due to the motor, and variations in resistance due to the air. Ramifications of hemp rope from these steel cables are sewn onto a canvas strip which in turn is sewn onto the gas bag. This part of the suspension is the same as in the "Drachen." The weight is distributed over the entire length of the gas bag.

The Car.—The car is 16.4 ft. long and is built of steel tubes and wire. It is large enough to hold the motor and three men, though four or five may be taken.

Motor.—The motor is a 110-HP. Daimler-Mercedes. Sufficient gasolene is carried for a run of 12 hours.

Propeller.—The propeller, like the suspension, is peculiar to this airship and is protected by patents. It has four cloth blades which hang limp when not turning. When the motor is running, these blades, which are carefully weighted with lead at certain points, assume the proper position due to the various forces acting. The diameter is 13¾ ft. The propeller is placed above the rear of the car near the center of resistance. Shaft transmission is used. The propeller makes 500 r.p.m. to 1,000 of the motor. There is a space of 6½ ft. from the propeller blades to the gas bag, the bottom of the car being about 30 ft. from the gas bag. This propeller has the advantage of being very light. Its position, so far from the engine, necessarily incurs a great loss of power in transmission.

The steering wheel at the front of the car, has a spring device for locking it in any position.

The 1908 model of this airship was constructed for the purpose of selling it to the Government. Among other requirements is a 12-hr. flight without landing, and a sufficient speed to maneuver against a 22-mi. wind. A third and larger airship of this type is now under construction.

THE ZEPPELIN.—The Zeppelin airship, of which there have been four, differs from all others in that the envelope is rigid. Sixteen separate gas bags are contained in an aluminum alloy framework having 16 sides, covered with a cotton and rubber fabric. The pressure of the air is taken up by this framework instead of by the gas bags. The gas bags are not entirely filled, thus leaving room for expansion.

The rigid frame is 446 ft. long, 42½ ft. in diameter, and has ogival-shaped ends. It is braced about every 45 ft. by a number of rods crossing near the center, giving a cross-section resembling a bicycle wheel. Vertical braces are placed at intervals the entire length of the frame. The 16 gas bags are completely separated from each other by partitions of sheet aluminum. Under the framework is a triangular truss running nearly the entire length, the sides of the triangle being about 8 ft. The total volume of the gas bags is 460,000 cu. ft. which gives a gross lift of about 32,000 lbs.

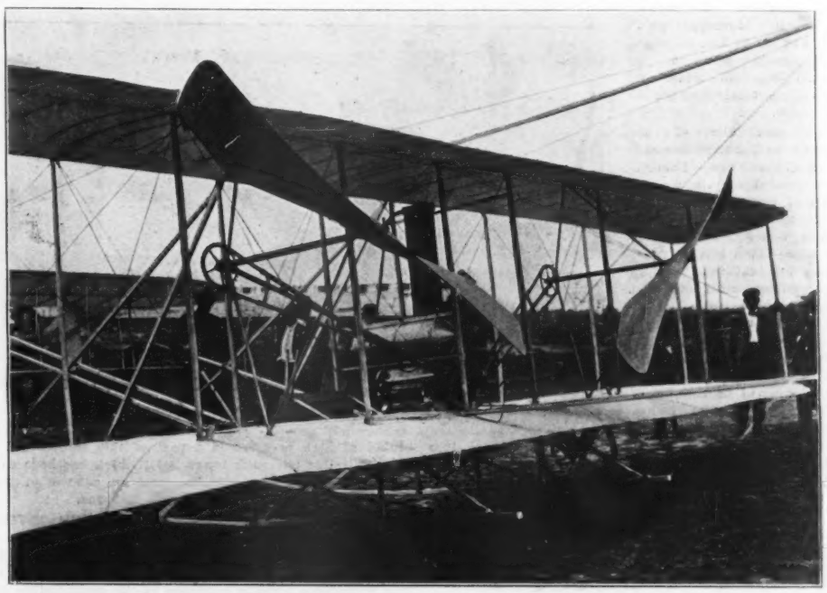

FIG. 7. WRIGHT BROTHERS' AEROPLANE; DETAILS OF CONSTRUCTION, REAR VIEW.

Suspension.—The two cars are rigidly attached directly to the frame of the envelope, and a very short distance below it.

Cars.—The two cars are built like boats. They are about 20 ft. long, 6 ft. wide, 3½ ft. high; are placed about 100 ft. from each end and are made of the same aluminum alloy. To land the airship, it is lowered until the cars float on the water, when it can be towed like a ship. A third car is built into the keel directly under the center of the framework, and is for passengers only.

Motors.—The power is furnished by two 110-HP. Daimler-Mercedes motors, one placed on each car. Each weighs about 550 lbs.; sufficient fuel for a 60-hr. run can be carried.

Propellers.—A pair of three-bladed metal propellers about 15 ft. in diameter is placed opposite each car, firmly attached to the frame of the envelope at the height of the center of resistance where they are most efficient.

Stability.—In addition to the long V-shaped keel under the rigid frame, on each side at the rear of the frame are two nearly horizontal planes, while above and below the rear end are vertical fins.

Steering.—A large vertical rudder is attached at the extreme end of the rigid frame, and an additional one is placed between each set of horizontal planes on the sides. For vertical steering, there are four sets of movable horizontal planes placed near the ends of the rigid frame, about the height of the propellers. Each set consists of four horizontal planes placed one above the

other and connected with rods, so that they work on the principle of a shutter. These horizontal rudders serve another very important purpose, due to the reaction of the air. When these planes are set at an angle of 15° and the airship is making a speed of 35 mi. per hr., an upward pressure of over 1,700 lbs. is exerted, and consequently all the gas in one compartment could escape and yet by the manipulation of these planes, the airship could return safely to its starting point.

Its best performances were two long trips made during the past summer. The first, July 4th, lasted exactly 12 hours, during which time it covered a distance of 235 miles, crossing the mountains to Lucerne and Zurich, and returning to the balloon house at Friedrichshafen on Lake Constance. The average speed on this trip was 32 mi. per hr. On Aug. 4 this airship attempted a 24-hr. flight, which was one of the requirements made for its acceptance by the Government. It left Friedrichshafen in the morning with the intention of following the Rhine as far as Mainz, and then returning to its starting point straight across the country. A stop of 4 hrs. 30 mins. was made in the afternoon of the first day on the Rhine to repair the engine. On the return, a second stop was found necessary near Stuttgart, due to difficulties with the motors and the loss of gas. While the ship was anchored to the ground a storm came up, and broke loose the anchorages; and as the balloon rose in the air it exploded and took fire, due to causes which have never been actually determined and published, and fell to the ground, resulting in its complete destruction.

On this journey, which lasted in all 31 hrs. 15 mins., the airship was in the air 20 hrs. 45 mins. and covered a total distance of 378 miles.

The patriotism of the German nation was aroused. Subscriptions were immediately opened and in a short space of time $1,000,000 had been raised. A Zeppelin Society was formed to direct the expenditure of this fund. Eighty-five thousand dollars has been expended for land near Friedrichshafen; shops are being constructed and it has been announced that within one year, the construction of 8 airships of the Zeppelin type will be completed. Recently the Crown Prince of Germany made a trip in the "Zeppelin No. 3," which had been called back into service, and within a very few days the Emperor of Germany visited Friedrichshafen for the purpose of seeing the airship in flight. He decorated Count Zeppelin with the Order of the Black Eagle. German patriotism and enthusiasm has gone further, and the "German Association for an Aerial Fleet" has been organized in sections throughout the country. It announces its intention of building fifty garages (hangars) for housing airships.

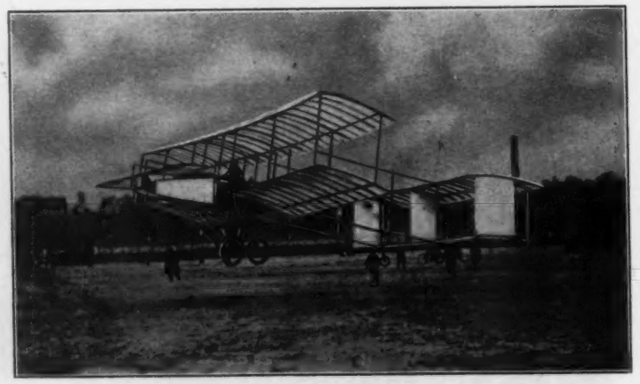

FIG. 8. THE FARMAN AEROPLANE.

UNITED STATES.

SIGNAL CORPS DIRIGIBLE NO. 1.—Due to lack of funds, the United States Government has not been able to undertake the construction of an airship sufficiently large and powerful to compete with those of European nations. However, specifications were sent out last January for an airship not over 120 ft. long and capable of making 20 mi. per hr. Contract was awarded to Capt. Thomas S. Baldwin, who delivered an airship last August to the Signal Corps, the description of which follows:

Gas Bag.—The gas bag is spindle shaped, 96 ft. long, maximum diameter 19 ft. 6 in. with a volume of 20,000 cu. ft. A ballonet for air is provided inside the gas bag, and has a volume of 2,800 cu. ft. The material for the gas bag is made of two layers of Japanese silk, with a layer of vulcanized rubber between.

Car.—The car is made of spruce, and is 66 ft. long, 2½ ft. wide and 2½ ft. high.

Motor.—The motor is a 20-HP. water-cooled Curtiss type.

Propeller.—The propeller is at the front end of the car, and is connected to the engine by a steel shaft. It is built up of spruce, has a diameter of 10 ft. 8 in. with a pitch of 11 ft., and turns at the rate of 450 r.p.m. A fixed vertical surface is provided at the rear end of the car to minimize veering, and a horizontal surface attached to the vertical rudder at the rear tends to minimize pitching. A double horizontal surface controlled by a lever and attached to the car in front of the engine, serves to control the vertical motion and also to minimize pitching.

The position of the car very near the gas bag is one of the features of the Government dirigible. This reduces the length and consequently the resistance of the suspension, and places the propeller thrust near the center of resistance.

The total lifting power of this airship is 1,350 lbs., of which 500 lbs. are available for passengers, ballast, fuel, etc. At its official trials a speed of 19.61 mi. per hr. was attained over a measured course, and an endurance run lasting two hours was made, during which 70% of the maximum speed was maintained.

"Dirigible No. 1," as this airship has been named, has already served a very important purpose in initiating officers of the Signal Corps in the construction and operation of a dirigible balloon. With the experience now acquired, the United States Government is in a position to proceed with the construction and operation of an airship worthy of comparison with any now in existence, but any efforts in this direction must await the action of Congress in providing the necessary funds.

BALLOON PLANT AT FORT OMAHA, NEBRASKA.—In anticipation of taking up the subject of aeronautics on a scale commensurate with its importance, a complete plant has been constructed at the Signal Corps post at Fort Omaha, Nebraska. This plant comprises a steel balloon house 200 ft. long, 84 ft. wide, and 75 ft. high; that is, large enough to house a dirigible balloon of the size of the new French military airship "Le Republique." For furnishing hydrogen gas, an electrolytic plant has been installed capable of furnishing 3,000 cu. ft. of gas per hr. A gasometer of 50,000 cu. ft. capacity has been provided to store a sufficient supply of gas for emergencies.

In connection with the hydrogen plant is a compressor for charging under pressure the steel tubes in which the gas is transported. A hydraulic pump for testing steel tubes at high pressure is a part of this equipment. A steel wireless telegraph tower 200 ft. high has been completed, and probably will be used in connection with wireless experiments with dirigible balloons.

SOME GENERAL CONSIDERATIONS WHICH GOVERN THE DESIGN OF A DIRIGIBLE BALLOON.

BUOYANCY AND SHAPE.—Although many data are needed for the proper design of a dirigible airship, yet the experience already available in the construction and performance of such ships built on different plans is sufficient to enable the engineer to proceed with the design of a dirigible balloon to accomplish definite results along fairly accurate lines. In the case of this class of lighter-than-air ships the following general equation obtains:

$$W - w = V\left(\sigma - \frac{\sigma}{n}\right) \quad \ldots\ldots\ldots (1)$$

where

W = weight of balloon, envelope, car and aeronauts
V = volume of balloon
σ = density of the air.
n = density of air as compared with gas
w = weight of air displaced by car and aeronauts and envelope of balloon.

If we call the weight of the gas in the balloon M, then we can write this equation in the following manner:

$$W + M = w + nM$$

from which we find that

$$M = \frac{W - w}{n - 1} \quad \ldots\ldots\ldots (2)$$

and

$$V = \left(\frac{W - w}{\sigma}\right)\left(\frac{n}{n - 1}\right) \quad \ldots\ldots\ldots (3)$$

thus obtaining the volume of gas required. If the volume of the gas bag, car, aeronauts, etc. $= v$, then $w = v\sigma$; so that (3) may be written

$$V = \left(\frac{W - v\sigma}{\sigma}\right)\left(\frac{n}{n - 1}\right) \quad \ldots\ldots\ldots (4)$$

Thus far, certainly, no dirigible balloon has ever been developed which, has attained an indepedent speed greater than 40 mi. per hr. It will readily be admitted that an airship so designed as to reach a speed of 50 or 60 mi. per hr. would be regarded as a more decided step forward in the art, since this difference of velocity is just the increment needed to place such craft on a practical basis capable of maneuvering in the air in all ordinary weather. This advancement, with such requiring much consideration, would fully compensate in practical results.

The first point to be decided upon in the design of an airship is the method of maintaining the shape of the gas bag against the pressure encountered at the maximum velocity to be attained. There are two methods of design in his respect, each having its adherents. One maintains the shape of the gas bag by a rigid internal frame, and the other by means of the internal pressure of the gas itself.

Upon the selection of the type depends to a large extent the particular shape of the envelope. If the envelope is to maintain its shape by interior pressure of gas, evidently it must be so designed that the minimum pressure of the air developed at the speed contemplated shall not be sufficient to cause deformation of any part of the envelope. This can be effected only by making the uniform internal pressure at least equal to the maximum external pressure. Since the maximum external pressure occurs over the prow of the airship, this evidently is the particular part which must receive most careful attention with this system.

The desirable shape of head would evidently be one where the distribution of external pressure due to air resistance at the velocity used is uniform. In addition to preventing deformation of the gas bag, a prime requisite also is that the shape shall be such that the total resistance, comprising head resistance and skin-friction shall be a minimum for a given displacement and velocity.

This immediately forces the question of the law of resistance of the air. On this subject there are numerous aerodynamic data for low velocities, and also for very high velocities, but such data are incomplete for the range of velocities here considered. In fact, the law of resistance of the air for surfaces of revolution as experimentally determined, is known to vary not with any constant power of the velocity, but by a range of exponents from the first to the cube, if not higher. For example, in the enormous velocities attained by modern artillery, where bodies weighing a ton or more are hurled through the air at 2,000 ft. per sec., it is known that the physical phenomena become entirely different in nature from those found when dealing with moderate velocities such as are met in transportation devices.

RESISTANCE OF THE AIR TO THE MOTION OF A PROJECTILE.—In the expression for the retardation of oblong projectiles the velocity enters with an exponent, n, whose accepted values are as follows:

		Ft. per sec.	Mi. per hr.
$n = 1.55$	for velocities greater than	2,600 =	1,773
$n = 1.7$	for velocities between	2,600 and 1,800 =	1,773 and 1,227
$n = 2.$	for velocities between	1,800 and 1,370 =	1,227 and 934
$n = 3.$	for velocities between	1,370 and 1,230 =	934 and 836
$n = 5.$	for velocities between	1,230 and 970 =	836 and 639
$n = 3.$	for velocities between	970 and 790 =	639 and 592
$n = 2.$	for velocities less than	790 =	592

14-in. and 16-in. Guns.—The 14-in. guns fire a projectile weighing 1,660 lbs. Service muzzle velocity 2,150 ft. per sec., which gives with an elevation of 15° a range of 15,000 yds.

The 16-in. guns fire a projectile weighing 2,400 lbs. The Service muzzle velocity is 2,150 ft. per sec., or 1,465 mi. per hr., which gives, for an elevation of 15° a range of 15,558 yds., or nearly nine miles.

ANALOGY TO AIRSHIP.—Great guns are now constructed which throw masses of steel weighing as high as 2,400 lbs. to maximum distances approximating 15 to 20 miles, and with such high momentum that ordinary winds have little effect, as shown by the remarkable target practice of the Army and Navy. The shapes of these heavier-than-air flying machines are figures of revolution, and the longitudinal and lateral stability are maintained by imparting to the projectile a rotary motion about its longer axis by means of the rifling inside the bore of the gun. Such machines are 5,000 or 6,000 times heavier than air and travel at speeds far beyond any other engine constructed by man. No peripheral speeds attained with any machinery approach these velocities.

It is noted that these projectile air-machines have a mass two and a half times that of the Wright aeroplane, and attain a velocity through the air thirty-six times as great.

It thus appears that the resistance of the air to the motion of bodies through it is in reality a complicated function of the velocity, and the best that can be said is that this velocity varies as a constant power only within certain limited ranges. In the velocities considered for airships, it is approximate to regard the resistance as varying as the square.

As the velocity increases the form of the head becomes more and more important, and moderate velocities lead to a shape approximating torpedo form, which is well

known. In very high speed projectiles the shape of the rear is not so important, since the velocity is so much greater than the velocity of sound in air, that a partial vacuum is formed behind the projectile which cannot well be obviated.

If the rigid system be employed where an internal frame prevents deformation of the envelope, the stresses due to external pressure are taken up by the framework itself, and the gas required for flotation is usually contained in several separate receptacles or ballonets similar to compartments employed in ships. In this system, therefore, we are concerned only in securing such a shape of the rigid frame as will fulfill the condition of minimum total resistance for a given displacement and velocity.

Once the shape of the bag is determined from the considerations already enumerated, the dimensions become immediately fixed when the tonnage is assumed, or conversely, if any linear dimension is assigned the tonnage is thereby determined.

In addition to the two general systems above considered, there are various types involving some of the principles of each, which are classed in general as semi-rigid systems. Such systems usually comprise a rigid frame, to which is attached the gas-bag above, and the load below.

AERODYNAMIC ADJUSTMENTS.—The next step is one of structural design along strictly engineering lines. The aerodynamic features of airship construction may be considered under the heads: (a) static balance; (b) dynamic balance; (c) stability; (d) natural period and oscillation.

Static Balance.—The dimensions of the gas-bag being determined, the lift of each transverse segment thereof is immediately known, and the design of the frame may proceed by approximate trial and correction as in other structural work. The weight of each segment of the envelope itself is readily computed, which added to the corresponding segment of the frame gives the total weight of each segment, and this total subtracted from the lift of each segment gives the net lift for that complete segment. From the magnitude and position of these net forces the position of the resultant lift is known, and this determines the vertical line through the center of gravity. Such procedure evidently insure static balance of the machine as a whole, and an approximate distribution of the load.

Dynamic Balance.—The dynamic balance must also be carefully considered; and here a difficulty has been experienced on account of the inability to place the resultant thrust coincident with the line of resistance of the ship as a whole. Heretofore, it has been customary to balance the thrust-resistance couple by means of suitable horizontal rudders or planes, so situated and at such angles, that the resultant moment of the system should be zero at uniform speeds of travel, though not necessarily zero for accelerated motion.

If, however, the line of thrust be made coincident with the line of resistance, the disturbing moment in question will be eliminated at uniform speeds. If, furthermore, the center of mass be located on the line of thrust and sufficiently forward to form a righting couple with the resistance when the wind suddenly veers, the evil effects of a disturbing moment will be obviated for variable as well as for constant speeds. The ship is then dynamically balanced.

This, of course, requires that the form of hull be such that a quartering wind shall exert a force passing to the rear of the center of mass. To illustrate, a good example of dynamic balance is found in a submarine torpedo, or a fish.

Stability.—The foregoing adjustments still allow the center of mass to be placed below the center of buoyancy. This is a provision that is important in aeronautics as well as in marine architecture, indeed it is the only practical provision for keeping an even keel and preventing heeling when the ship is at rest, or simply drifting with the wind. If the center of gravity be well below the center of buoyancy, the vessel is proportionately stable, but, of course, the stability is pendular, and may admit of considerable rolling and pitching due to shifting loads, sudden gusts of wind, etc., unless special devices be used to dampen or prevent these effects.

Natural Period and Oscillations.—It may happen also that the equilibrium of the ship is disturbed by periodic forces whose periods are simply related to the natural period of the ship itself. In this case the oscillations will be cumulative and may become very large. Such effects are well known to marine engineers, and may be treated as in ordinary ship design.

Aviation.

This division comprises all those forms of heavier-than-air flying machines which depend for their support upon the dynamic reaction of the atmosphere. There are several subdivisions of this class dependent upon the particular principle of operation. Among these may be mentioned the aeroplane, orthopter, helicopter, etc. The only one of these that has been sufficiently developed at present to carry a man in practical flight is the aeroplane. There have been a large number of types of aeroplanes tested with more or less success and of these the following are selected for illustration.

REPRESENTATIVE AEROPLANES OF VARIOUS TYPES.

The Wright Brothers' Aeroplane.—The general conditions under which the Wright machine was built for the Government were, that it should develop a speed of at least 36 mi. per hr., and in its trial flights remain continuously in the air for at least one hour. It was designed to carry two persons having a combined weight of 350 lbs. and also sufficient fuel for a flight of 125 miles. The trials at Fort Myer, Va., in September of 1908, indicated that the machine was able to fulfill the requirements of the government specifications.

The aeroplane has two superposed main surfaces 6 ft. apart with a spread of 40 ft. and a distance of 6½ ft. from front to rear. The area of this double supporting surface is about 500 sq. ft. The surfaces are so constructed that their extremities may be warped at the will of the operator.

A horizontal rudder of two superposed plane surfaces about 15 ft. long and 3 ft. wide is placed in front of the main surfaces. Behind the main planes is a vertical rudder formed of two surfaces trussed together about 5½ ft. long and 1 ft. wide. The auxiliary surfaces, and the mechanism controlling the warping of the main surfaces, are operated by three levers.

The motor, which was designed by the Wright brothers, has four cylinders and is water cooled. It develops about 25 HP. at 1,400 r. p. m. There are two wooden propellers 8½ ft. in diameter which are designed to run at about 400 r. p. m. The machine is supported on two runners, and weighs about 800 lbs. A monorail track is used in starting.

FIG. 9. THE AEROPLANE, "JUNE BUG," HAMMONDSPORT, N. Y.
(Built by the Aerial Experiment Association.)

The Wright machine has attained an estimated maximum speed of about 40 mi. per hr. On Sept. 12, a few days before the accident which wrecked the machine, a record flight of 1 hr., 14 min., 20 sec. was made at Fort Myer, Va. Since that date Wilbur Wright, at Le Mans, France, has made better records; on one occasion remaining in the air for more than an hour and a half with a passenger.

THE HERRING AEROPLANE.—The Signal Corps of the Army has contracted with A. M. Herring, of New York, to furnish an aeroplane under the conditions enumerated in the specification already referred to and shown in the appendix to this paper. Mr. Herring made technical delivery of his machine at the aeronautical testing ground at Fort Myer, Va., on Oct. 13.

In compliance with the request of Mr. Herring the details of this machine will not be made public at present, but the official tests required under the contract will be conducted in public as has been the case with other aeronautical devices. Opportunity will be afforded any one to observe the machine in operation.

This machine embodies new features for automatic control and contains an engine of remarkable lightness.

THE FARMAN AEROPLANE.—The Farman flying machine has two superposed aerosurfaces 4 ft. 11 ins. apart with a spread of 42 ft. 9 ins. and 6 ft. 7 ins. from front to rear. The total sustaining surface is about 560 sq. ft.

A box tail 6 ft. 7 ins. wide and 9 ft. 10 ins. long in rear of the main surfaces is used to balance the machine. The vertical sides of the tail are pivoted along the front edges, and serve as a vertical rudder for steering in a horizontal plane. There are two parallel, vertical partitions near the middle of the main supporting surfaces, and one vertical partition in the middle of the box tail. A horizontal rudder in front of the machine is used to elevate or depress it in flight.

The motor is an eight-cylinder Antoinette of 50 HP., weighing 176 lbs., and developing about 38 HP. at 1,050 r. p. m.

The propeller is a built-up steel frame covered with aluminum sheeting, 7½ ft. in diameter, with a pitch of 4 ft. 7 ins. It is mounted directly on the motor shaft immediately in rear of the middle of the main surfaces.

The framework is of wood, covered with canvas. A chassis steel tubing carries two pneumatic-tired bicycle wheels. Two smaller wheels are placed under the tail. The total weight of the machine is 1,106 lbs. The main surfaces support a little over 2 lbs. per sq. ft. The machine has shown a speed of about 28 mi. per hr. and no starting apparatus is used.

On Jan. 13, 1908, Farman won the *Grand Prix* of the Aero Club of France in a flight of 1 min. 28 sec., in which he covered more than a kilometer. It is reported that on Oct. 30, 1908, a flight of 20 miles, from Mourmelon to Rheims, was made with this machine.

THE BLERIOT AEROPLANE.—Following Farman's first flight from town to town, M. Bleriot with his monoplane aeroplane made a flight from Toury to the neighborhood of Artenay and back, a total distance of about 28 kilometers. He landed twice during these flights and covered 14 kilometers of his journey in about 10 minutes, or attained a speed of 52 mi. per hr.

THE JUNE BUG.—The "June Bug" was designed by the Aerial Experiment Association, of which Alexander Graham Bell is President. It has two main superposed aerosurfaces with a spread of 42 ft. and 6 ins., including wing tips, with a total supporting surface of 370 sq. ft.

The tail is of the box type. The vertical rudder above the rear edge of the tail is 30 ins. square. The horizontal rudder in front of the main surfaces is 30 ins. wide by 8 ft. long. There are four triangular wing tips pivoted along their front edges for maintaining transverse equilibrium. The vertical rudder is operated by a steering wheel, and the movable tips by cords attached to the body of the aviator.

The motor is a 25-HP., 8-cylinder, air-cooled, Curtiss type. The single wooden propeller immediately behind the main surfaces is 6 ft. 2 ins. in diameter and mounted directly on the motor shaft. It has a pitch angle of about 17° and is designed to run at about 1,200 r. p. m.

The total weight of the machine, with aviator, is 650 lbs. It has a load of about 1¾ lbs. per sq. ft. of supporting surface. Two pneumatic-tired bicycle wheels are attached to the lower part of the frame.

With this machine, Mr. G. H. Curtiss, on July 4, 1908, won the "Scientific American" trophy by covering the distance of over a mile in 1 min. 42⅘ sec. at a speed of about 39 mi. per hr.

SOME GENERAL CONSIDERATIONS WHICH GOVERN THE DESIGN OF AN AEROPLANE.

The design of an aeroplane may be considered under the heads of (a) support, (b) resistance and propulsion, (c) stability and control.

SUPPORT.—In this class of flying machines, since the buoyancy is practically insignificant, support must be obtained from the dynamic reaction of the atmosphere itself. In its simplest form, an aeroplane may be considered as a single plane surface moving through the air. The law of pressure on such a surface has been determined and may be expressed as follows:

$$P = 2\,k\,\sigma\,A\,V^2 \sin\alpha \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

in which P is the normal pressure upon the plane, k is a constant of figure, σ the density of the air, A is the area of the plane, V the relative velocity of translation of the plane through the air, and α the angle of flight.

This is the form taken by Duchemin's formula for small angles of flight such as are usually employed in practice. The equation shows that the upward pressure on the plane varies directly with the area of the plane, with the sine of the angle of flight, with the density of the air, and also with the square of the velocity of translation.

It is evident that the total upward pressure developed must be at least equal to the weight of the plane and its load, in order to support the system. If P is greater than the weight the machine will ascend, if less, it will descend.

The constant k depends only upon the shape and aspect of the plane, and should be determined by experiment. For example, with a plane 1 ft. square $k\,\sigma = 0.00167$, as determined by Langley, when P is expressed in lbs. per sq. ft., and V in ft. per sec.

Equation (1) may be written

$$A\,V^2 = \frac{P}{2\,k\,\sigma \sin\alpha}.$$

If P and α are kept constant then the equation has the form

$$A\,V^2 = \text{constant} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Principle of Reefing in Aviation.—An interpretation of (2) reveals the interesting relation of supporting area varying inversely as the square of the velocity. For example, in the Wright aeroplane, the supporting area at 40 mi. per hr. is 500 sq. ft., while if the speed is in-

creased to 60 miles per hour this area need be only $\frac{500}{1.5^2}$ = 222 sq. ft., or less than one-half of its present size. At 80 mi. per hr. the area would be reduced to 125 sq. ft., and at 100 mi. per hr. only 80 sq. ft. of supporting area is required. These relations are conveniently exhibited graphically on Fig. 10.

It thus appears that if the angle of flight be kept constant in the Wright aeroplane, while the speed is increased to 100 mi. per hr., we may picture a machine which has a total supporting area of 80 sq. ft., or a double surface each measuring about 2½ by 16 ft. or 4 by 10 ft. if preferred. Furthermore, the discarded mass of the 420 sq. ft. of the original supporting surface may be added to the weight of the motor and propellers in the design of a reduced aeroplane, since in this discussion the total mass is assumed constant at 1,000 lbs.

In the case of a bird's flight, its wing surface is "reefed" as its velocity is increased, which instinctive

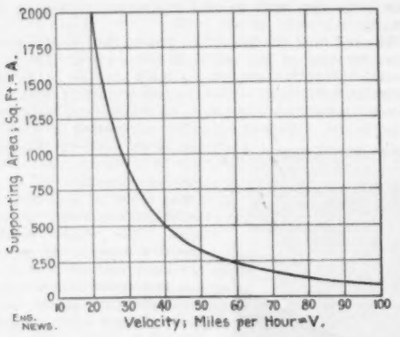

Fig. 10. Velocity Area Curve for "Reefed" Aeroplane.
(Computed from Results with the Wright Aeroplane.)

action serves to reduce its head resistance and skin-frictional area, and the consequent power required for a particular speed.

Determination of K for Arched Surfaces.—Since arched surfaces are now commonly used in aeroplane construction, and as the above equation (1) applies to plane surfaces only, it is important to determine experimentally the value of the coefficient of figure k, for each type of arched surface employed, especially as k is shown in some cases to vary with the angle of flight a; i. e., the inclination of the chord of the surface to the line of translation.

Assuming a constant, however, we may compare the lift of any particular arched surface with a plane surface of the same projected plan and angle of flight.

To illustrate, in the case of the Wright aeroplane, let us assume

P = 1,000 lbs. = total weight = W.
A = 500 sq. ft.
V = 40 mi. per hr. = 60 ft. per sec.
a = 7° approximately.

Whence $$k\sigma = \frac{P}{2\,A\,V^2 \sin a} = \frac{1{,}000}{2 \times 500 \times 60^2 \times \frac{1}{8}}$$
$$= 0.0022 \quad (V = \text{ft. sec.})$$
$$= 0.005 \quad (V = \text{mi. hr.})$$

Comparing this value of $k\sigma$ with Langley's value 0.004 for a plane surface V being in miles per hour, we see that the lift for the arched surface is 25% greater than for a plane surface of the same projected plan. That is to say, this arched surface is dynamically equivalent to a plane surface of 25% greater area than the projected plan. Such a plane surface may be defined as the "equivalent plane."

RESISTANCE AND PROPULSION.—The resistance of the air to the motion of an aeroplane is composed of two parts: (a) the resistance due to the framing and load; (b) the necessary resistance of the sustaining surfaces, that is, the drift, or horizontal component of pressure; and the unavoidable skin-friction. Disregarding the frame, and considering the aeroplane as a simple plane surface, we may express the resistance by the equation

$$R = W \tan a + 2\,f\,A \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

in which R is the total resistance, W the gross weight sustained, a the angle of flight, f the friction per square unit of area of the plane, A the area of the plane. The first term of the second member gives the drift, the second term the skin-friction. The power required to propel the aeroplane is

$$H = R\,V$$

in which H is the power, V the velocity.

Now W varies as the second power of the velocity, as shown by equation (1), and f varies as the power 1.85, as will be shown later. Hence we conclude that the total resistance R of the air to the aeroplane varies approximately as the square of its speed, and the propulsive power practically as the cube of speed.

Most Advantageous Speed and Angle of Flight.—Again, regarding W and A as constant, we may, by equation (1), compute a for various values of V, and find f for those velocities from the skin-friction table to be given presently. Thus a, R, and H may be found for various velocities of flight, and their magnitudes compared. In this way the values in Table I. were computed for a soaring plane 1 ft. square weighing 1 lb., assuming $k\sigma = 0.004$, which is approximately Langley's value when V is in miles per hour.

TABLE I.—COMPUTED POWER REQUIRED TO TOW A PLANE ONE FOOT SQUARE, WEIGHING ONE POUND, HORIZONTALLY THROUGH THE AIR AT VARIOUS SPEEDS AND ANGLES OF FLIGHT.

Velocity. Miles per hr.	Angle of flight. Degrees.	Computed resistance. Drift. Lb.	Friction. Lb.	Total. Lb.	Tow-line power. Ft.-lbs. per sec.	Lift per tow-line HP. Lbs.
30	8.25	0.145	0.0170	0.162	7.13	77.1
35	5.94	0.104	0.0226	0.1266	6.51	84.3
40	4.52	0.790	0.0289	0.1079	6.32	86.7
45	3.55	0.0621	0.0360	0.0981	6.39	86.1
50	2.88	0.0500	0.0439	0.0939	6.89	80.2
60	2.03	0.0354	0.0614	0.0962	8.50	64.7
70	1.47	0.0257	0.0814	0.1071	11.00	50.0
80	1.12	0.0195	0.1045	0.1240	14.56	35.8
90	0.88	0.0154	0.1300	0.1454	19.17	28.7
100	0.71	0.0124	0.1584	0.1708	25.00	22.0

Column two, Table I., giving values of a for various speeds, is computed from equation (1).

Column three is computed from the term "$W \tan a$" in equation (3).

Column four is computed from the term "$2\,f\,H$," in equation (3), f being taken from the skin-friction table to be given presently.

The table shows that if a thin plane 1 ft. square, weighing 1 lb. be towed through the air so as just to float horizontally at various velocities and angles of flight, the total resistance becomes a minimum at an angle of slightly less than 3°, and at a velocity of about 50 mi. per hr.; also that the skin-friction approximately equals the drift at this angle. The table also shows that the propulsive power for the given plane is a minimum at a speed of between 40 and 45 miles per hour, the angle of flight then being approximately 4.5°

The last column of the table shows that the maximum weight carried per horse-power is less than 90 lbs. This "horse-load" may be increased by changing the foot square plane to a rectangular plane and towing it long-side foremost; also by lightening the load, and letting the plane glide at a lower speed; but best of all, perhaps, by arching it like a vulture's wing and also towing it long-side foremost as is the prevailing practice with aeroplanes.

These relations are exhibited graphically in the diagrams, Figs 11 and 12.

STABILITY AND CONTROL.—The question of stability is a serious one in aviation, especially as increased wind velocities are encountered. In machines of the aeroplane type there must be some means provided to secure fore and aft stability and also lateral stability.

A large number of plans have been proposed for the accomplishment of these ends, some based upon the skill of the aviator, others operated automatically, and still others employing a combination of both. At the present time no aeroplane has yet been publicly exhibited which is provided with automatic control. There is little difference of opinion as to the desirability of some form of automatic control.

The Wright aeroplane does not attempt to accomplish this, but depends entirely upon the skill of the aviator to secure both lateral and longitudinal equilibrium, but it is understood that a device for this purpose is one of the next to be brought forward by them. Much of the success of the Wright brothers has been due to their logical procedure in the development of the aeroplane, taking the essentials, step by step, rather than attempting everything at once, as is so often the practice with inexperienced inventors.

The aviator's task is much more difficult than that of the chauffeur. With the chauffeur, while it is true that it requires his constant attention to guide his machine, yet he is traveling on a roadway where he can have due warning through sight, of the turns and irregularities of the course.

The fundamental difference between operating the aeroplane and the automobile, is that the former is traveling along an aerial highway which has manifold humps and ridges, eddies and gusts, and since the air is invisible he cannot see these irregularities and inequalities of his path, and consequently cannot provide for them until he has actually encountered them. He must feel the road since he cannot see it.

Some form of automatic control whereby the machine itself promptly corrects for the inequalities of its path is evidently very desirable. As stated above, a large number of plans for doing this have been proposed, many of them based on gyrostatic action, movable side planes, revolving surfaces, warped surfaces, etc. A solution of this problem may be considered as one of the next important steps forward in the development of the aeroplane.

Hydromechanic Relations.

SOME GENERAL RELATIONS BETWEEN SHIPS IN AIR AND WATER.

At the present moment, so many minds are engaged with the general problem of aerial navigation that any method by which a broad forecast of the subject can be made is particularly desirable. Each branch of the subject has its advocates, each believing implicitly in the superiority of his method. On the one hand the adherents of the dirigible balloon have little confidence in the future of the aeroplane, while another class have no energy to devote to the dirigible balloon, and still others prefer to work on the pure helicopter principle. As a matter of fact, each of these types is probably of permanent importance, and each particularly adapted to certain needs.

Fortunately for the development of each type the experiments made with one class are of value to the other classes, and these in turn bear close analogy to the types of boats used in marine navigation. The dynamical properties of water and air are very much alike, and the equations of motion are similar for the two fluids, so that the data obtained from experiments in water, which are very extensive, may with slight modification be applied to computations for aerial navigation.

Helmholz's Theorem.—Von Helmholz, the master physicist of Germany, who illuminated everything he touched, has fortunately considered this subject, in a paper written in 1873. The title of his paper is "On a Theorem Relative to Movements That Are Geometrically Similar in Fluid Bodies, Together With an Application to the Problem of Steering Balloons."

In this paper Helmholz affirms that, although the differential equations of hydro-mechanics may be an exact expression of the laws controlling the motions of fluid, still it is only for relatively few and simple experimental cases that we can obtain integrals appropriate to the given conditions, particularly if the cases involve viscosity and surfaces of discontinuity.

Hence, in dealing practically with the motion of fluids, we must depend upon experiment almost entirely, often being able to predict very little from theory, and that usually with uncertainty. Without integrating, however, he applies the hydrodynamic equations to transfer the observations made on any one fluid with given models and speeds, over to a geometrically similar mass of another fluid involving other speeds, and models of different magnitudes. By this means he is able to compute the size, velocity, resistance, power, etc., of aerial craft from given, or observed, values for marine craft.

He also deduces laws that must inevitably place a limit upon the possible size and velocity of aerial craft without, however, indicating what that limit may be with artificial power. Applying this mode of reasoning to large birds he concludes by saying that, "It therefore appears probable that in the model of the great vulture, nature has already reached the limit that can be attained with the muscles as working organs, and under the most favorable conditions of subsistence, for the magnitude of a creature that shall raise itself by its wings and remain a long time in the air."

In comparing the behavior of models in water and air, he takes account of the density and viscosity of the media, as these were well known at the date of his writing, 1873; but he could not take account of the sliding, or skin-friction, because in his day neither the magnitude of such friction for air, nor the law of its variation with velocity had been determined.

Skin-Friction in Air.—Even as late as Langley's experiments, skin-friction in air was regarded as a negligible

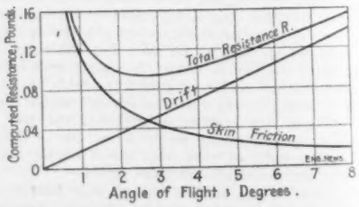

Fig. 11. Resistance Characteristics of a Foot-Square Plane Towed Horizontally Through the Air.

quantity, but due to the work of Dr. Zahm, who was the first to make any really extensive and reliable experiments on skin-friction in air, we now can estimate the magnitude of this quantity. As a result of his research he has given in his paper on atmospheric friction the following equation:

$$f = 0.0000078\ l - 0.07\ v^{1.85} \ldots (v = \text{ft. per sec.})$$
$$f = 0.0000158\ l - 0.07\ v^{1.85} \ldots (v = \text{mi. per hr.})$$

in which f is the average skin-friction per square foot, and l the length of surface.

From this equation the accompanying table of resistances was computed, and is inserted here for the convenience of engineers:

TABLE II.—FRICTION PER SQUARE FOOT FOR VARIOUS SPEEDS AND LENGTHS OF SURFACE.

Wind speed mi. per hr.	Average Friction in Lbs. per Sq. Ft. 1-ft. plane.	2-ft. plane.	4-ft. plane.	8-ft. plane.	16-ft. plane.	32-ft. plane.
5	0.000303	0.000289	0.000275	0.000262	0.000250	0.000238
10	0.00112	0.00105	0.00101	0.000967	0.000922	0.000878
15	0.00237	0.00226	0.00215	0.00205	0.00195	0.00186
20	0.00402	0.00384	0.00365	0.00349	0.00332	0.00317
25	0.00606	0.00579	0.00551	0.00527	0.00501	0.00478
30	0.00850	0.00810	0.00772	0.00736	0.00701	0.00668
35	0.01130	0.0108	0.0103	0.0098	0.00932	0.00888
40	0.0145	0.0138	0.0132	0.0125	0.0125	0.0114
50	0.0219	0.0209	0.0199	0.0190	0.0181	0.0172
60	0.0307	0.0293	0.0279	0.0265	0.0253	0.0242
70	0.0407	0.0390	0.0370	0.0353	0.0337	0.0321
80	0.0522	0.0500	0.0474	0.0452	0.0431	0.0411
90	0.0650	0.0621	0.0590	0.0563	0.0536	0.0511
100	0.0792	0.0755	0.0719	0.0685	0.0652	0.0622

The numbers within the rules represent data coming within the range of observation. These observations show that

"the frictional resistance is at least as great for air as water, in proportion to their densities. In other words, it amounts to a decided obstacle in high speed transportation. In aeronautics it is one of the chief elements of resistance both to hull-shaped bodies and to aero-surfaces gliding at small angles of flight."

Relative Dynamic and Buoyant Support.—Peter Cooper-Hewitt has given careful study to the relative behavior of ships in air and in water. He has made a special study of hydroplanes, and has prepared graphic representations of his results which furnish a valuable forecast of the problem of flight.

Without knowing of Helmholz's theorem, Cooper-Hewitt has independently computed curves for ships and hydroplanes from actual data in water, and has employed these curves to solve analogous problems in air, using the relative densities of the two media, approximately 800 to 1, in order to determine the relative values of support by dynamic reaction and by displacement for various weights and speeds.

An analysis of these curves leads to conclusions of importance, some of which are as follows:

(1) The power consumed in propelling a displacement vessel at any constant speed, supported by air or water, is considered as being two-thirds consumed by skin-resistance, or surface resistance, and one-third consumed by head resistance. Such a vessel will be about ten diameters in length, or should be of such shape that the sum of the power consumed in surface friction and in head resistance will be a minimum (torpedo shape).

(2) The power required to overcome friction due to forward movement will be about one-eighth as much for a vessel in air as for a vessel of the same weight in water.

(3) Leaving other things out of consideration, higher speeds can be obtained in craft of small tonnage by the dynamic reaction type than by the displacement type, for large tonnages the advantages of the displacement of type are manifest.

(4) A dirigible balloon carrying the same weight, other things being equal, may be made to travel about twice as fast as a boat for the same power; or be made to travel at the same speed with the expenditure of about one-eighth of the power.

(5) As there are practically always currents in the air reaching at times, a velocity of many miles per hour, a dirigible balloon should be constructed with sufficient power to be able to travel at a speed of about 50 mi. per hr., in order that it may be available under practical conditions of weather. In other words, it should have substantially as much power as would drive a boat, carrying the same weight, 25 mi. per hr., or should have the same ratio of power to size as the "Lusitania."

Motors.—It is the general opinion that any one of several types of internal combustion motors at present available is suitable for use with dirigible balloons. With this type, lightness need not be obtained at the sacrifice of efficiency. In the aeroplane, however, lightness per output is a prime consideration, and certainty and reliability of action is demanded, since if by chance the motor stops, the machine must immediately glide to the earth. A technical discussion of motors would of itself require an extended paper, and may well form the subject of a special communication.

Propellers.—The fundamental principles of propellers are the same for air as for water. In both elements, the thrust is directly proportional to the mass of fluid set in motion per second. A great variety of types of propellers have been devised, but, thus far only the screw-propeller has proved to be of practical value in air. The theory of the screw-propeller in air is substantially the same as for the deeply submerged screw-propeller in water, and therefore does not seem to call for treatment here. There is much need at present for accurate aerodynamic data on the behavior of screw-propellers in air, and it is hoped that engineers will soon secure such data, and present it in practical form for the use of those interested in airship design.

Limitations.—Euclid's familiar "square-cube" theorem connecting the volumes and surfaces of similar figures, as is well known, operates in favor of increased size of dirigibles, and limits the possible size of heavier-than-air machines in single units and with concentrated load.

It appears, however, that both fundamental forms of aerial craft will likely be developed, and that the lighter-than-air type will be the burden-bearing machine of the future, whereas the heavier-than-air type will be limited to comparatively low tonnage, operating at relatively high velocity. The helicopter type of machine may be considered as the limit of the aeroplane, when by constantly increasing the speed, the area of the supporting surfaces is continuously reduced until it practically disappears. We may then picture a racing aeroplane propelled by great power, supported largely by the pressure against its body, and with its wings reduced to mere fins which serve to guide and steady its motion. In other words, starting with the aeroplane type; we have the dirigible balloon on the one hand as the tonnage increases, and the helicopter type on the other extreme as the speed increases. Apparently, therefore, no one of these forms will be exclusively used, but each will have its place for the particular work required.

Aerial Locomotion in Warfare.

Whatever may be the influence of aerial navigation upon the art of war, the fact which must be considered at present is, that each of the principal military powers is

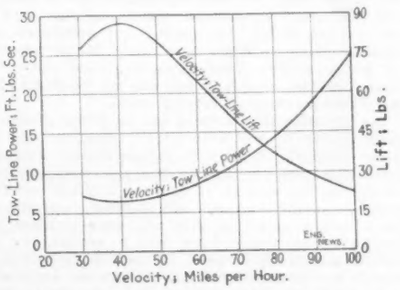

Fig. 12. Relations Between Velocity and Lift and Power Required of a Foot-Square Plane Towed Horizontally.

displaying feverish activity in developing this auxiliary as an adjunct to the military establishment.

If each of the great powers of the world would agree that aerial warfare should not be carried on, the subject would be of no great interest to this country as far as our military policy is concerned, but until such an agreement is made this country is forced to an immediate and serious consideration of this subject in order to be prepared for any eventuality. The identical reasoning which has led to the adoption of a policy of providing for increasing our navy year by year to maintain our relative supremacy on the sea, is immediately applicable to the military control of the air. If the policy in respect to the navy is admitted, there is no escape from the deduction that we should proceed in the development of ships of the air on a scale commensurate with the position of the nation.

The question as to whether or not the powers will ultimately permit the use of aerial ships in war is not at present the practical one, because in case such use is authorized it will be too late adequately to equip ourselves after war has been declared.

ACTION OF THE HAGUE PEACE CONFERENCE.

The following is the declaration signed by the delegates of the United States to the Second International Peace Conference held at The Hague, June 15 to Oct. 19, 1907, prohibiting the discharge of projectiles and explosives from balloons, ratified March 10, 1908.

Declaration:

The Contracting Powers agree to prohibit, for a period extending to the close of the Third Peace Conference, the discharge of projectiles and explosives from balloons or by other new methods of a similar nature.

The delegates of the United States signed this declaration. The countries which did not sign the declaration forbidding the launching of projectiles and explosives from balloons were: Germany, Austria-Hungary, China, Denmark, Ecuador, Spain, France, Great Britain, Guatemala, Italy, Japan, Mexico, Montenegro, Nicaragua, Paraguay, Roumania, Russia, Servia, Sweden, Switzerland, Turkey, Venezuela.

It appears that the United States is the only first-class power which signed this agreement, and an analysis of the text of the agreement itself shows that no serious attempt was made to settle the question finally. For instance, while the war balloon may not discharge projectiles or explosives from above, yet no reciprocal provision is made preventing such war balloon from being fired upon from the earth below, yet the law of self-defense evidently obtains. Furthermore, naval experts will tell you that they fear no enemy quite as much as a submarine mine, whose location is unknown and which gives no warning when it is approached. Our own experience shows that the battleship "Maine" could be completely destroyed in time of peace without any one detecting the preparations for its accomplishment.

If, then, a nation can submerge a mine for the destruction of ships from underneath the water, why can it not drop an aerial mine upon a ship from above? And if it should be allowed to drop an aerial mine upon an enemy's fortified ship at sea, it certainly should be allowed to drop such an aerial mine upon a fortified place on land.

INFLUENCE ON THE MILITARY ART.

The military art, up to the present time, has been practically conducted in a plane where the armies concerned have been limited in their movements in time and place by the physical character of the terrane. A large army, for instance, cannot move faster than about 12 miles a day by marching, and the use of railroads as applied to the art of war was first recognized in the Franco-Prussian war. By their use, the mobilization of the great Prussian army and its accurate assembling in the theater of operations, within ten days, contributed an initial advantage not before possible.

The very essence of strategy is surprise, and there never were better opportunities than at present for a constructive general to achieve great victories. But these victories to be really great, must be founded upon some new development or use of power not heretofore known in war. They must also tend to produce results with the minimum loss of human life. In other words, the sentiment of the world demands that the military art shall always aim to capture, not destroy. It may be said, that the consummation of military art is found in maneuvering the enemy into untenable situations, thereby forcing a decisive result with a minimum loss of life and treasure. As to the technical use of dirigible balloons and aeroplanes in warfare we have nothing but theory at present to guide us. It would appear, however, in the case of dirigible balloons that two different classes of such ships should be developed:

(1) This is a comparatively small dirigible type with a capacity of from 50,000 to 100,000 cu. ft., to be used principally for scouting purposes and to a limited extent for carrying explosives for demolitions or for incendiary purposes, such as destroying bridges and supply depots close to the mobile army or coast defense fortress. Reconnoitering dirigibles of this class, in order to be safe during daytime, will have to maneuver at an altitude of about a mile, but experiments show that telephotographic apparatus will operate from this height to give much detail. At night, such dirigibles may descend to within a few hundred feet of the ground with safety and thus obtain much valuable information. Equipped with wireless telegraph or telephone apparatus, military data could be obtained and transmitted without undue risk. Due to the small carrying capacity of such sizes, the radius of action would probably be limited at present to about 200 miles.

(2) This type of dirigible may be developed for burden-bearing purposes. It has been pointed out above that the larger the airship the greater the speed it may be given, and the greater its radius of action. There is no reason to doubt, that airships of capacity, from 500,000 to 1,000,000 cu. ft. may be ultimately developed to attain speeds of 50 to 75 mi. per hr. With a capacity for such speed, the aerial craft becomes a powerful practical engine of war which may be used in all ordinary weather. By keeping high in the air in daytime, and descending at night, they may launch high explosives, producing great damage. Being able to pass over armies and proceed at great speeds, their objectives would not usually be the enemy's armies, but their efforts would be directed against his base of supplies; to destroy his dry docks, arsenals, ammunition depots, principal railway centers, storehouses, and indeed the enemy's navy itself.

It is thought that there will be little difficulty in launching explosives with accuracy, provided good maps and plans are available. Due to the small cost of such ships as compared with naval vessels, the risk of loss would be readily taken.

The element of time has always been a controlling factor in warfare. It is often a military necessity to conduct a reconnoissance in force to develop the enemy's dispositions. This requires at times a detachment of several thousand men from the main army, for a considerable period of time to accomplish this end. With efficient military airships, these results may be attained with a very few men in a small fraction of the time heretofore required.

Delimitation of Frontiers.—The realization of aerial navigation for military purposes, brings forward new questions regarding the limitation of frontiers. As long

as military operations are confined to the surface of the earth, it has been the custom to protect the geographical limits of a country by ample preparations in time of peace, such as a line of fortresses properly garrisoned. At the outbreak of war these boundaries represent real and definite limits to military operations. Excursions into the enemy's territory usually require the backing of a strong military force. Under the new conditions, however, these geographic boundaries no longer offer the same definite limits to military movements. With a third dimension added to the theater of operations, it will be possible to pass over this boundary on rapid raids for obtaining information, accomplishing demolitions, etc., returning to safe harbors in a minimum time. We may, therefore, regard the advent of military ships of the air, as, in a measure, obliterating present national frontiers in conducting military operations.

One of the military objectives in warfare is usually the enemy's capital city, his ministers and his chief executive. This objective has heretofore been protected by large armies of soldiers, who, in themselves are not so important to the result. In order to attain the objective, it has been frequently necessary to subdue large numbers of soldiers needlessly.

With the advent of efficient ships of the air, however, small parties may pass over these protective armies on expeditions aimed at the seat of government itself, where reside the body of particular individuals most responsible, so that the ultimate result will be to deter a rash entrance into war for personal ends; since now for the first time responsible individuals of state may be in immediate and personal danger after the declaration of war, which heretofore has not been usually the case.

INTERIOR HARBORS.

In the development of these larger types of dirigible balloons the main difficulty will be in providing suitable harbors or places of safety, for replenishing supplies and for seeking shelter in times of stress. As long as the dirigible balloon remains in the air it may be regarded as tolerably safe, both in itself, and as a conveyance for observers. If its engines are disabled, it is at least a free balloon and may be operated as such. When brought in contact with the ground, however, it is in considerable danger from high winds. The momentum of such an enormous airship is great, and the comparatively fragile structure of the craft makes it an easy prey to the pounding which it is likely to receive when landing. Just as marine ships must seek a sheltered harbor or put to the open sea in times of storm, so in case of ships of the air, it is much more necessary either to brave the storm in the open, or to seek some sheltered harbor on land.

Fortunately, in this case, certain suitable harbors for very large ships may be provided at small expense, by using narrow and deep valleys and ravines, surrounded by forests or other protection, or prepared railway cuts, etc., where the airship may descend and be reasonably safe from the winds above. These harbors should, of course, be known to the pilot, and carefully plotted on his maps beforehand. The compass bearings of each harbor from prominent points on land must be known and plotted, to assist as far as possible in navigating the airship in thick weather; and such harbors may be indicated to the pilot at night by vertical searchlight beams, or by suitable rockets, etc.

The aeroplane, as has been pointed out, is likely to prove a flying machine of comparatively low tonnage and high speed. It is not likely to become a burden-bearing ship, at least in single units, but will be extremely useful for reconnoitering purposes; for dispatching important orders and instructions at high speed; for reaching inaccessible points; or for carrying individuals of high rank and command to points where their personality is needed.

One of the bloodiest contests the world has ever seen, was the Japanese attack on "203 Meter Hill," yet, the sole object of this great slaughter, was for the purpose of placing two or three men at its summit to direct the fire of the Japanese siege guns upon the Russian fleet in the harbor at Port Arthur.

If the United States had possessed in 1898 a single dirigible balloon, even of the size of the one now at Fort Myer, Viriginia, which cost less than $10,000, the American army and navy would not have long remained in doubt of the presence of Cervera's fleet in Santiago harbor.

The world is undoubtedly growing more humane year by year. We have arrived at a conception of the principle of an efficient army and navy, not to provoke war, but to preserve peace, and it is believed, that, following this principle, the perfection of ships of the air for military purposes will materially contribute, on the whole, to make war less likely in the future than in the past.

FLOOD PREVENTION at Kansas City, Mo., is to be provided by the Kaw Valley Drainage Board. It is proposed to remove obstructions which restrict the channel of the river and retard the flood outflow, and also to construct dikes along the banks in certain localities. A bond issue of $375,000 has been voted by the district to be benefited by the improvements. It is proposed to make the clear channel of the river 734 ft. in width.

THE RELATION OF RAILWAYS TO CANALS.*

By JOHN F. STEVENS, M. Am. Soc. C. E.

Within sixty years—about one hardy business lifetime—our railway main lines have risen from nothing to 225,000 miles, over which traffic, both freight and passenger, is carried, at speeds equal to, and at rates, generally speaking, lower than in other countries, where the cost of labor and material is much less than with us, and where the density of tonnage is far greater. But a time has now come when the railways, considered as a unit, are not capable of handling satisfactorily the interchange business of the country, even supplemented as they are to a certain extent by water lines.

The gigantic strides our internal commerce has made, have demonstrated that while railways serve a purpose which waterways can never do, they need to be supplemented by a cheaper, if a slower carrier. There are immense volumes of low-grade traffic, which to be moved at all require very low rates. Such traffic is now being handled by the railways to the detriment of their other and faster-moving business, resulting in a loss to themselves and to the public also.

There seems to be a general impression that the railways are opposed to the exploitation and construction of canals. That there is good ground for such opinion, the writer does not believe. The consensus of opinion among our ablest, most far-sighted railway owners and executives is undoubtedly that canals, properly planned, honestly financed and constructed, will not only aid the development of the country, but will create new business, and be of assistance and value to the railways themselves.

It is improbable that private capital can be found to finance—excepting, possibly, in a few unimportant instances—such systems of canals as the public needs may find necessary; and if the demand—which is already insistent—that the national government take up the matter, is granted, then it clearly devolves upon the national authorities to see to it that such systems are so planned, and the work is so executed, that the greatest good to the greatest number will result. And such work will naturally divide itself into three classes: the improvement of harbor facilities; the enlargement and control of rivers; and the creation of new and the rebuilding upon more generous lines of existing canals.

The improvement of harbors, and the fitting of such of them as may be most available, in connection with interior transportation lines, to become suitable terminals for foreign business, is in itself a great and important work; and the mistake of spending millions for deep water, for ample room with safe anchorage, and neglecting to provide means for cheap and quick exchange between ships and interior lines, must be avoided. By the lack of such foresight, New York has built up Baltimore, Norfolk and Newport News, and the business which now avoids her port, because it can be done cheaper elsewhere, will never come to her doors. In fact, the providing of ample and well-arranged terminals is the greatest single item among the many which go to make up the total of efficient transportation facilities.

The matter of building a railroad at the present day is a different proposition than it was in years past. Now, as a first preliminary, the amount, nature and probable revenue of all prospective traffic seeking movement, is carefully estimated. These factors, with such reasonable additions as future development may seem to warrant, fix the character of the road to be built, from right of way to equipment, and hence, the amount of the investment in the proposed enterprise. And the same sound principles should be observed in the planning of canals. They should be fitted for the work they will be called upon to do, as far as it can be predicated.

First, and foremost, should come the big trunk lines, to be built where no doubt can exist that the business waits, or will develop, for them, and where nature has provided, without prohibitory cost, physical conditions which make them feasible.

After such trunk line or lines are decided upon, then the question of branch or feeder lines should be given the same careful consideration, and the relations of such minor links in the general scheme, to the whole, including the railways, should be thoroughly worked out; and the dimensions which govern the capacity and consequent cost of operation of every one, trunk and branch lines alike, should only be decided after the most intelligent and painstaking inquiry, remembering always, that the cost and delay of transferring freight from one vehicle to another is generally more than the hauling of it for many miles.

The construction of a canal, or of a system of canals, is a simple matter, as compared to the conception of, and the correct solution of all the preliminaries.

Once financial means are assured, once we establish the policy that such adjuncts to our present lines of traffic are to be provided, a wild and senseless scramble will ensue for "a slice from the pork barrel." Every little town, every city—not to mention every state—will demand to have its own little pet canal, and such demands once conceded, would not only cover the face of nature with useless and unsightly scars, but would drive the nation, and probably some of our states, nearly to bankruptcy. The only way to prevent such wasteful results will be to take the whole matter absolutely out of politics—as much so as are the deliberations of our national supreme court.

We might have a commission large enough in numbers so that the details of work could be divided among them, not large enough to become unwieldy, the members to be selected, not by reason of party proclivities, or geographical distribution, but because of their knowledge, ability as business and transportation men, in the broadest meaning of the terms. Such men should be paid salaries commensurate with those they can earn in private life, and the tenure of their office should be fixed, not by the caprice of political necessity, but by a natural age limit of retirement, with a fair pension thereafter until the end of life. If we are going to spend, as has been suggested, from fifty to one hundred million dollars each year for an indefinite period, we can spend none of it more wisely, than in providing the very best counsel and supervision that the talent of the United States affords.

Such a commission should be given the final power of decision, not only as to details, but also as to the general, and, in fact, all features; with the authority to examine, accept or reject, as it saw fit, any project advanced for consideration; to plan and to carry into execution, by contract, or otherwise, any work it might decide upon as proper to be done, subject, of course, only to regulated financial limitations.

And such a course would, it is believed, meet with the approval of leading men of the railway world, in common with all other thinking citizens. It would be as much—probably more—to the benefit of the railroads to have the locating, planning and construction of waterways carried along on sound business principles, as it could possibly be to the rest of the commercial interests of the country.

Looking into the future, there is another factor, which, although a side issue, may become a very important one. In the construction of canals, as a natural result, there will be the development of a large amount of water-power, which, properly handled, can be made to produce, at a low cost, power, heat and light, through the medium of electricity. This will enable us to conserve our coal supply, and thus to add millions to our material resources which we are drawing so heavily upon. And no interest is more concerned in the cheapness of power—whether produced from coal or any other agency—than the railroads. For this reason alone, they should feel a deep concern in the successful inauguration of a canal system from which they are bound to derive such substantial benefits.

*Extract from a paper read at the first annual convention of the Atlantic Deeper Waterways Association, Baltimore, Nov. 17-19, 1908.

THE NEW BASCULE DRAWBRIDGE of the Chicago & Northwestern Ry., crossing the north branch of the Chicago River at the throat of the present Wells St. terminal station, Chicago, is said to be the largest and heaviest single-leaf double-track bascule bridge in the world. It is of the Strauss trunnion type and has an overhead counterweight. It will carry about 200 trains daily, in addition to switching movements, and will be opened about 1,000 times per month for the river traffic. The trunnion pier is carried 115 ft. to bed rock, to provide ample stability in the event of the widening and deepening of the river channel. The clear span is 140 ft. The counterweight is a 1,200-ton concrete block carried by pivots at the tail end of the bridge. This stands normally above the tracks, but descends to within a short distance from the rails when the bridge is opened. The 28-in. trunnions are in the top chord. The bridge is operated by two 50-HP. motors, geared to driving pinions which engage with two racks having pin teeth. There are two sources of 500-volt direct-current supply, and also a pneumatic driving system and a hand driving system. These are provided to ensure against any failure of power to operate the bridge, which would block a heavy and important traffic. It is stated that the bridge can be operated easily by hand. There are solenoid and hand brakes, with an automatic device for applying the brakes when the bridge has reached the end of its movement. The locking mechanism includes a front support for taking live load off the trunnion, and a truss lock at the rear end. These are operated by a 3-HP. motor which is automatically cut out when the movements are completed. The rail joints are mitered and are self-locking. The bridge requires about 45 HP. and can be swung in about one minute.

The design for the superstructure was made by the Strauss Bascule & Concrete Bridge Co. The foundations were built by the Great Lakes Dredge & Dock Co. The superstructure material was built by the Toledo-Massillon Bridge Co., and was erected by the Kelly-Atkinson Construction Co. The work was under the direction of Mr. E. C. Carter, Chief Engineer of the Chicago & Northwestern Ry.; Mr. W. H. Finley, Assistant Chief Engineer, and Mr. I. F. Stern, Bridge Engineer. Mr. W. C. Curtis was Resident Engineer.

REINFORCED-CONCRETE FREEZING TANKS.*

By WILLIAM M. TORRANCE.†

Concrete, properly made, is an ideal substance to use for freezing tanks. Reinforced-concrete engineers now have the subject of stresses and strains in their specialty as well in hand as in the case in the design of steel work, and reinforcing steel is easily placed in the concrete base and walls of the tank where needed to keep the structure from cracking open from hydraulic or temperature stresses. Competent concrete constructors can be found who know how to make and place the concrete properly so as to make it water-tight and so as to avoid planes of cleavage or of weakness sometimes found in the work of less competent contractors. The forms must be designed and the work laid out so that there will be no stoppage of work, no places where new work has to be joined to old work, but the work must all be done for any one tank so as to make it truly monolithic.

The concrete tanks with which the speaker has had experience were made as shown in Fig. 1. The reinforcement was cold twisted steel bars ⅝-in. square, placed 12 ins. c. to c. in each direction, so that the entire area of base and sides was gridironed. By calculation for range of temperature of from —10° F. to +90° F. these rods were found sufficient to take care of temperature strains. The vertical rods in the side were made continuous with those crossing each other in the base, the bend at the corner being made cold so as to preserve for the steel the extra strength due to twisting the rod in the first place. This bend is near the inner surface of the concrete, while the general location of rod is near the center of the slab. This is brought near the inner surface to take care of the stresses induced at the corner by the hydraulic pressure of the brine against the sides of the tank.

In these tanks the insulation consisted of screened cinders filled with coal-tar pitch. [Not shown in the cut.—Ed.] This kind of insulation is not recommended by some, but, nevertheless, it has much to recommend it. Cinders cost nothing but transportation as a rule—very little more than that, in any case—and coal-tar pitch besides being comparatively inexpensive is impervious to moisture as well as being a fairly good insulator. There can be little question but that, being a mineral substance, its life as an insulator will exceed that of a purely vegetable substance. Being incapable of absorbing moisture it will always remain insulating. If the cinders are well and truly screened of all dust and the spaces between the individual pieces of cinders deposited loosely, are well and truly filled with the boiling hot pitch, one could not ask for a better result than will be obtained, provided, of course, that sufficient thickness of the insulation be used. Another great advantage of this type of insulation, whether used outside a steel tank or outside a concrete tank, is its additional property of non-absorption of moisture, being, if well placed, a waterproofing. Thus, if the brine, or any portion of it, could find an opening through the steel or concrete it could not leak away through or into this form of insulation, thus being wasted and spoiling the insulation at the same time.

The insulation on the top of the foundation was placed before the tank was built. That on the sides was placed afterwards, the outside concrete forms being moved back and the cinders and tar being placed in the space between them and the finished concrete wall.

After consultation with such authorities as were obtainable it was decided that the concrete itself has about the same insulation coefficient as a brick wall or about half that of the cinders and tar, so that for the same degree of perfection in insulation several inches of the thickness of this cinder and tar mixture were saved, or the insulation value was increased to that extent, whichever way you look at it, by use of the concrete tank instead of a steel one.

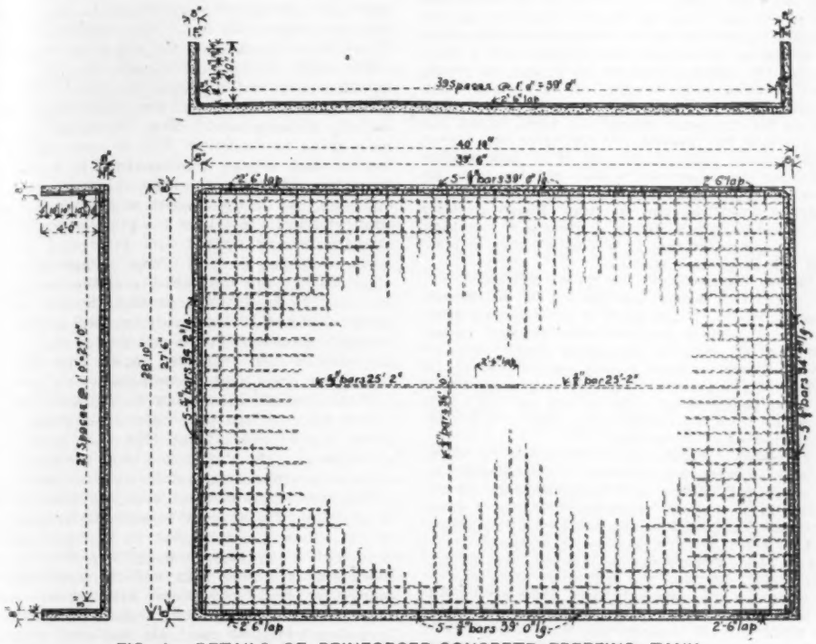
395 spaces @ 1' 0" = 39' 0"
2' 6" lap
40' 10"
39' 6"
5-¾" bars 39' 0" lg.
2' 6" lap
2' 6" lap
5-¾" bars 34' 2" lg.
5-¾" bars 34' 2" lg.
¾" bars 25' 2"
¾" bars 25' 2"
¾" bars 34' 2" lg.
375 spaces @ 1' 0" = 31' 0"
28' 10"
27' 6"
2' 6" lap
5-¾" bars 39' 0" lg.
2' 6" lap

FIG. 1. DETAILS OF REINFORCED-CONCRETE FREEZING TANK.
(Cinder and tar insulation described in the article is not shown in the cut.)

Often we hear of steel tanks that are worn out after only a few seasons of use. This is often due to the habit of the operatives of strengthening their brine by adding common salt (Na Cl) instead of the calcium chloride ($Ca Cl_2$), which they should have on hand, but which is either lacking or from the operatives standpoint, too expensive. This common salt, of course, rusts the tank out very rapidly. While to many this might not be considered a recommendation for concrete this practice would not injure a concrete tank, as neither Na Cl brine, nor $Ca Cl_2$ brine would have any chemical effect on well-made concrete. In fact, with a concrete tank installation it might be found to be cheaper to use Na Cl altogether and not get the more expensive $Ca Cl_2$.

For the benefit of those of you who would not use anything but cork board or similar insulation, I have devised a tank of reinforced concrete with this insulation. Of course, in the use of such a substance not perfectly impervious to moisture, we must protect it on both sides. It would not do to simply place two or three inches of cork board in place of the eight inches of tar and cinders and let it go at that, but means must be employed to keep it from becoming saturated with moisture from the outside.

Fig. 2 shows the scheme for doing this. This shows the tank proper, built outside the insulation, the reinforcement being of same type as in Fig. 1. This reinforcement need not be so heavy, however, as it will not be subjected to the same temperature conditions as is the case in the other scheme.

In construction this tank would be built perfectly monolithic, as in the other case, the reinforcement being made long enough at the top to be bent over the top of the insulation and down in front, as shown. On the inside of this wall so built, a coating of hot tar would be placed on the inside surface immediately after the forms are removed and against this a 2-in. layer of cork board would be secured by fastening it with wire or other appliances, previously partially imbedded in the concrete. Then inside this cork board, a 5-ply felt and tar waterproofing, or equally effective waterproofing, would be placed. This, as shown, would consist of six layers of tar alternating the five layers of felt and would be about an inch thick, adding considerably to the insulation. After this is placed and the ends of the reinforcement rods bent over and down, as shown, a protecting layer of 2-in. thicknesses of concrete would be placed. Light chicken wire reinforcement in the middle of this 2 ins. will insure perpetual absence of cracks in this protection concrete.

Complicated as this scheme seems, it is comparatively inexpensive, when compared with a steel tank of 5/16-in. metal with 4 ins. of corkboard outside of it. It is incomparably more impervious to leakage than this last mentioned construction, as it would not leak at all, and while the two schemes start out about even as to insulation, in the case of the special concrete construction, the insulation is absolutely protected against ever absorbing moisture and thus being spoiled, while in the other case, unless additional expense for drainage or protection be adopted, the insulation would in a short time become saturated and spoiled, either from leakage from within or from ground water from without. Then, of course, this construction has the same advantage in allowing the use of Na Cl brine, previously discussed, as well as being absolutely waterproof.

[In the discussion of this paper considerable opposition was developed against the use of the tar-and-cinder insulation, but those opposing its use had had experience with it only in wooden and steel tanks and not in instances where the concrete wall offered additional protection. The author stated that the style of construction shown in Fig. 1 would cost the contractor about 60 cts. per sq. ft. of surface, insulation included, but the contractor's profit and guarantee would add to the cost to the ice-making company.

In further criticism of the paper, one member denied the statement that Na Cl was more destructive to steel tanks than $Ca Cl_2$, and claimed that, from an extensive experience with both, it might be said that the sodium salt is the safer to use.—Ed.]

*Paper delivered before the annual meeting of the American Society of Refrigerating Engineers, New York City, Nov. 30-Dec. 1, 1908.

†Constructing Engineer, 253 Broadway, New York City.

RAILWAY SLIDES AND WASHOUTS.*

SLIDES.

Slides may be classified as follows: (1) slips of material on the sides of the embankment, away from the roadbed; (2) slips of portions of the cut toward the roadbed; (3) slides of land moving down to a lower level.

Slides of embankments are endless in variety and magnitude. They always occur in wet weather. The earth becomes surcharged with water, which increases its weight and at the same time lessens its cohesion. The slide starts on a plane of rupture, usually curved, and often cumulates in a lobe or heap at the foot of the slope.

Slides in excavation are especially annoying, as they block the roadbed and stop drainage.

As to land slides, when a field or a country side or a mountain spur slides, it is usually beyond human control, and we are compelled to allow the irresistible forces of nature to have full sway.

The underlying cause of nearly all slides is water. The radical cure of slides in most cases is a problem of drainage, surface and subterranean, and is often difficult and costly.

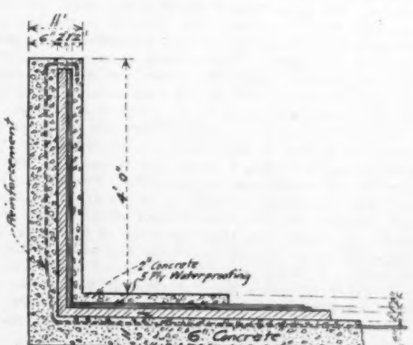

Fig. 2. Suggested Detail of Corner of Reinforced-Concrete Freezing Tank Insulated with Cork Board.

The driving of piles on both embankment and excavation to hold sliding masses is very often resorted to. It is never more than a temporary expedient, and is advisable only in special cases.

Retaining walls at foot of slope may sometimes be necessary where right-of-way is restricted. But in the

*Abstract of a circular issued by the Roadway Committee of the American Railway Engineering and Maintenance-of-Way Association.

open country in nearly all cases where the ground can be obtained, the flattening of the slope is the most economical, the most efficient and permanent method of treatment. The lobe at lower end of slide often gives a good point of support or foothold for the filling used in restoring the roadbed.

In embankment slides, the roadbed can be restored after it is dried out in a measure, by filling in with suitable material. Usually the steam shovel will be the best method to use.

The way to get rid of slides in cuts, is to take them out by the cheapest and speediest way possible. Only in rare instances are other methods of treating efficient.

WASHOUTS.

It is assumed that washouts can only occur when the water in streams overflows the sides of their channels, spreads over low-lying lands, and attains velocity enough to carry away the material of which the roadbed is built.

Flood waters in nearly all cases carry on their destructive work in one of the three following modes: (1) They scour around the ends of embankments, bridges or other structures near the water courses; (2) the waters force themselves through embankments at the weakest points; (3) they overtop the embankment and overflow the track crossing the valleys.

The remedy for the first is to reinforce the wings of bridges and other structures projecting into the floods with material which is sufficiently hard, durable and heavy to resist the erosion, dissolving action and forces of the flood water.

The material eminently adapted to this is riprap of stone or any available substance. The riprap is preferably built up in symmetrical shape in rough courses by hand about exposed places to above the flood height. Sometimes it is as good and more economical to throw in the riprap pellmell, and let it take its permanent place under the forces of gravity, current, silt deposit, etc., plying upon it. The judgment of the intelligent, responsible man in charge of maintenance of the district can be relied upon to determine the details.

As to the second destructive flood mood, where it forces itself through the embankment, interrupting the traffic and carrying away more or less of the permanent way, there is to be considered: (A) the cause of the break; (B) the means of speedily resuming traffic; (C) the permanent restoration of the roadbed; (D) the prevention of a recurrence of the trouble.

(A) The predominating cause of breaks through embankments has been the partial or sometimes nearly complete blocking up of the waterway with obstructions of drift or other things. Wherever water runs there may be assumed to have been provided a waterway of some kind. This becoming obstructed, forces the water to rise until it overtops the embankment, and eats its way down through it, or the pressure forces the water along the outside of pipe or culvert through partial voids or weak spots, and accomplishes the same destructive work.

(B) If the flood is of short duration, the quickest and cheapest way is to let it run out, and then restore the break. If the flood lasts a considerable length of time, excessive carrying away of embankment should be prevented by means of gunny sacks or other available means. The usual way of restoring the track, and the speediest way of restoring the track so traffic can be resumed if the break is of small dimensions, is to crib up with old timber or ties as soon as men can be secured to do the work. The water will nearly always be low enough to work by the time material for cribbing is loaded and moved to the scene of operations.

If a flood continues to pour through the break, or if the break is long or deep, resort to pile driving is the best thing. For this a pile-driver is essential which can reach forward one or preferably two bents. In very long breaks there should be a pile-driver on each end, working day and night without stopping until the break is bridged. An abundant force of bridgemen is needed to put on caps, stringers and rail, so as to cause no delay. A prime requisite is an ample and convenient supply of bridge material close at hand. For a large break on dry ground it will pay well to build a temporary track alongside to truck the material forward. It can be floated if there is water.

If the bottom is hard rock, which will not admit of penetration of piles, it may be necessary to use frame bents, anchored against the force of the current, with ropes and other devices.

(C) When once traffic is resumed, the work of permanent restoration of roadway may be proceeded with more leisurely, the object being, not as in temporary repairs to get trains over in the shortest possible time, but to make it of good flood-resisting material, placed in the most substantial manner, so the break will not occur again.

(D) Even more important than again rebuilding with flood-resisting material to prevent recurrence of break is to provide ample waterway. While the working out of a suitable formula for the size of openings draining limited areas is both interesting and profitable, for all practicable purposes the allowing of 1 sq. ft. of opening for a minimum of four and a maximum of six acres drained, has prevented breaks from floods where it has been applied during the past generation. In large basins, the only safe and defensible way is to provide ample openings. The rule practiced by the late eminent irrigation engineer, Col. Nettleton, of Denver, is worthy of consideration. His method was to get all known high-water marks, average all the known data, and then provide just twice as much flood opening.

As to the third class of destructive flood work, by the overflow of flood water, the roadbed should be built of material which will stand much washing. It is of great advantage to have the track ballasted with hard angular broken stone, which will not readily be carried away with the current. The track on all bridges subject to overflow should be securely anchored. On embankment subject to frequent overflow, the track should be secured by driving stout stakes against lower end of ties, or by driving stakes on upper side and wiring track to them, tying to trees or by other available means. If there is only slack water, it is best to do nothing but run trains through the water, having care to provide a firm roadbed. If the water rises slowly, walls of gunny sacks can be made on one side or other. Sometimes the upper side is best, and sometimes the lower side. The object to prevent cutting away of embankment should be kept in view. Riprap on lower side of embankment subject to overflow is of vast benefit. The permanent cure is to raise a strong embankment well above flood heights.

SIDE WASH ALONG ALLUVIAL STREAMS.

If there is a shallow rock bottom, it can be protected by riprip. If the depth of rock is considerable, the side of roadway may sometimes be most cheaply reinforced and protected with steam shovel work. If material largely composed of rock can be obtained, the material can be handled much more economically by machinery than by hand. The washing away of a large portion of it by the currents may still leave this the cheaper method of protection.

If the bank is alluvial and the rock deep or absent, the work of protection with rock is interminable; the soft bottom will swallow up more rock than can be furnished. In these cases, protection by means of woven willow mats of suitable width, with graded slopes above the low water, paved with stone as developed by the Missouri River Commission, is the best and cheapest method. Full details of this method are to be found in the reports of the Missouri River Commission. The cost of this work for railway embankment protection has been found to be $6 to $7 per lin. ft. of roadway, with a mat 45 to 60 ft. wide and corresponding revetment of somewhat less width.

COAL BRIQUETTING.

A paper on "Coal Briquetting," by Mr. Carl Scholz, Vice-President of the Rock Island Coal Mining Co., was read before the Western Society of Engineers on Nov. 18. The paper did not deal with the mechanical side of the question, but mainly with its commercial aspects. Briquetting is generally considered in regard to (1) the utilization of fine coal, or (2) the production of a fuel which is superior to raw coal. The first is a very large problem, owing to the surplus of fine coal and the increasing percentage of the smaller sizes. The latter is of interest to engineers and consumers when high efficiency, smokeless combustion and storage qualities are essential.

Several briquetting plants have been established in this country, but most of the plants were short lived, and the production of briquettes is still small. The unsatisfactory results were due probably to insufficient investigation of the conditions, and to reliance upon experience in foreign countries, where the difference between the selling prices of lump and fine coal is greater than in this country. Owing to the development of mechanical stokers and the increase in industrial plants there is in some section of the United States (including the central coal field, with Illinois and Indiana) very little difference in the selling price of the coarser and finer sizes.

The investigations made by the U. S. Geological Survey have shown that no one process of briquetting can be applied successfuly to the various classes of coal. In general, lignite and light coals should be made into briquettes of 2 to 3 lbs. in weight; bituminous coals, 10 to 24 oz.; anthracite coal and coke dust, 1½ to 6 oz.

The advantages of briquetting include the following: (1) greater efficiency of combustion; (2) absence of clinker and cinders; (3) reduction of smoke due to more perfect combustion; (4) absence of dust; (5) better storage; (6) decreased loss due to degradation. With raw coal the heating in the furnace causes the coal to crack, resulting in an escape of gases which cannot obtain the proper admixture of oxygen. With briquettes, their compactness retards the process of combustion, which can only proceed at a uniform rate.

The briquetting machines in use are mainly of the rotary type (with molds formed in two rolls whose faces are in contact), and the plunger type. A large item of expense in this country is the binder. This is usually made from pitch, varying in proportion according to the quality and hardness of the coal. Mr. Scholz uses about 7% of pitch which has a melting point of 175° F.

The Rock Island Coal Mining Co. has a briquetting plant in Oklahoma. The coal is screened, and the coal and pitch are then mixed in a Jeffrey disintegrator. The conveyors run at such speed as to deliver 93% of coal and 7% of the cracked pitch. The mixture is heated by steam in vertical cylinders having revolving agitators, and is then fed to a Renfrow briquetting machine, which is of the plunger type. This machine was described and illustrated in our issue of Sept. 6, 1906. The briquettes weigh about 13 oz., and the capacity of the machine is 10 tons per hour. The product (known by the trade name of "carbonets") is used mainly for domestic purposes, but it is expected that it will be adopted for thrashing and other engines where the grate area is comparatively small.

If the cost of binder could be reduced, the fuel might be used for locomotive and steam purposes, but at present the high cost makes this prohibitive. The briquettes can be stored for two years without appreciable loss in heat value.

The discussion was not very favorable to the briquetting of coal as a commercial proposition. Mr. A. Bement stated that he has had experience with many projectors and inventors in this line, and as a rule they had no knowledge of market or trade conditions, and did not want any information of this kind. All were convinced that they had good machines and good projects, and that they only needed money to start a profitable business. One inventor proposed to buy ordinary coal, crush it, make briquettes of it, and sell the product at a higher price than the cost of coal owing to the superior quality of the briquettes as fuel!

There is a marked difference in the briquetting of washed and unwashed coal. The latter contains fine dust which fills the voids and makes a compact briquette with only a small amount of the binding medium. Briquettes of cylindrical shape, with rounded ends, are well adapted for good combustion, as they pack together in the furnace and still leave air spaces for the draft.

Mr. J. K. Deering, of the Deering Coal Co., remarked that coal men are interested, as they want to find some way of making their small coal available. The briquetting system seems to promise a solution of the problem. If Illinois slack coal can be briquetted and then burned without smoke, the briquettes may command a higher price than the raw material.

Mr. Scholz stated, in closing the discussion, that a pound of coal in briquette form will evaporate more water than a pound of the same coal in its raw state, owing to the more favorable conditions for complete combustion at a uniform rate.

A POWER SHOVEL FOR UNDERGROUND WORK has been put into use by the American Zinc, Lead & Smelting Co., Joplin, Mo., and the installation of a second and third shovel is contemplated. This machine differs essentially from the ordinary steam shovel only in the use of compressed air instead of steam for driving its engines. In the second shovel to be installed, it is planned to further reduce the height and radial reach. In a descriptive article published in "The Engineering and Mining Journal" for Nov. 28, the clearance width of this second shovel is given as 7 ft. 6 ins.; clearance height, 12 ft.; swing of boom, 16 ft.; horizontal travel of trolley, 4 ft. 6 ins.; capacity of dipper, ¾-cu. yd. Three compressed air engines will be provided: One, 5 ins. × 6 ins. for hoisting, and two 4 ins. × 5 ins. for swinging and crowding, respectively. The machine now in use was built by the Thew Automatic Shovel Co., of Lorain, Ohio, and is a modification of their standard steam shovel.

REINFORCED-CONCRETE PIPE WITH REINFORCED JOINT.

The Lock Joint Pipe Co., of New York, is manufacturing reinforced-concrete pipe which is novel in having the reinforcement utilized also for making the joint between successive lengths. The sketch Fig. 1 herewith, a longitudinal section of the joint, shows how this is done. The mesh reinforcement projects from the concrete at both hub and spigot, and these projections overlap in the joint. Cement mortar filled into the dovetailed recess at the inside of the joint locks the overlapping metal together and at the same time makes the joint tight. A better idea of the appearance of the unjointed pipe as well as of the jointing is given by the view Fig. 2, which shows in the foreground the unjointed spigot end of a length of pipe at the rear, inside, a joint just being made up.

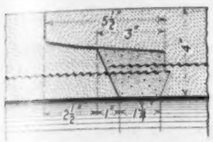

Fig. 1. Meriwether Lock Joint for Reinforced - Concrete Pipe.

This pipe is made in diameters of 24 to 72 ins., usually in 3-ft. lengths (the 24, 27 and 30-in. pipe is made in 4-ft. lengths). In laying the pipe, the lengths are simply pushed together, the reinforcing metal (expanded metal) which projects from the spigot being entered into that of the bell. Cementing the joints need not be done at this time, in fact it should not, as the operation of laying the adjoining lengths of pipe might disturb the setting of the cement. With the larger sizes, backfilling may be done before the jointing, as the work is done from the inside.

A 1:2 mortar is used for the jointing. In the smaller sizes of pipe the joints are poured or grouted from the outside, against a spring-steel ring clamped into the pipe over the joint-space. A small piece must be chipped or broken out of the bell to admit the grout. The head obtained is sufficient to fill the joint solid without the use of a pump. Where the pipe is large enough to permit working inside conveniently, the lower

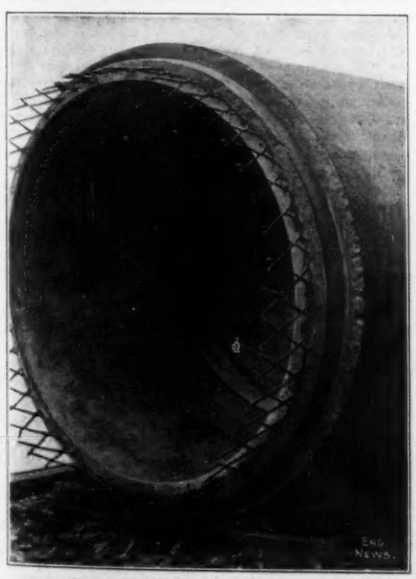

Fig. 2. View of Spigot End of Lock-Joint Pipe.

(Vent joint partly filled with mortar. The pipe photographed was specially made for a test of greatest attainable strength of joint, for which reason the expanded metal was placed with larger dimension of mesh lengthwise of the pipe. For ordinary cases the meshes run the other way, giving something over twice as great a bursting strength.)

half or two-thirds of the joint is troweled (the mortar being mixed to a suitable consistency) and then the remaining upper part is filled by pumping grout behind a semi-circular steel form strip braced upward against the pipe.

A test of the longitudinal strength of this type of joint was made recently at the plant of The Snead & Co. Iron Works, Jersey City, N. J. The 3-ft. lengths of 36-in. pipe were cast, and after they were some weeks old they were placed together and jointed, forming a 9-ft. length. When the joint mortar was 10 days old, the pipe was laid on supports about 7 ft. apart, as a beam, and load was applied at the center by cast-iron blocks and columns laid on a saddle on the pipe. The ends of the pipe having been dammed up, water was poured into the pipe to show if the joints should leak. A total load of 10,550 lbs. was applied, but no crack could be detected in the pipe and no water leaked through the joints.

This load would give a bending moment of about $24 \times 5{,}400 = 127{,}200$ in.-lbs. at the joint. With a moment of resistance, $\frac{\pi d^2 t}{4}$, calculated on a diameter of 36 ins., or $I/c = 1{,}018t$, this gives a tension at the bottom of the joint of $\frac{127{,}200}{1{,}018t} =$ 125 lbs. per lin. in. of joint.

The pipe itself is generally manufactured at the site where it is to be laid. The molds for making it are detailed by Fig. 3; this is for a 36-in. pipe, but the same details, in substance, apply to other sizes. The shape and length of bell and spigot are the same for all sizes, viz.: Spigot, 3½ ins. long over all, 2½ ins. long to back of bevel; Bell, 5½ ins. deep; Joint, 3 ins. wide at back, 1¾ ins. wide at front, with average depth equal to half the thickness of pipe. The pipe thickness varies from 3 ins. for 24-in. pipe to 7 ins. for 72-in. pipe.

The construction of the molds, comprising a one-piece cast-iron base ring, parted inner and outer shells, and a top ring, together with angle-iron rings, which are slipped inside the inner shell and outside the outer shell to produce a truly circular form, needs no explanation other than Fig. 3 gives. The pipe is usually made of 1:2:4 concrete, with gravel 1 in. and less in size. The recess in the base ring for the bell projection of reinforcement is filled with sand around the expanded metal, to give a bed for the cement. At the top, the cement is leveled off in continuation of the sloping mold as shown by full lines. Recently, the molds have been made as shown by dotted lines, to facilitate working the concrete into the top of the mold, but the end is troweled off to the beveled outline as before. The top ring and shells are removed 24 hrs. after casting, but the pipe is allowed to stand undisturbed on the base ring for three days longer.

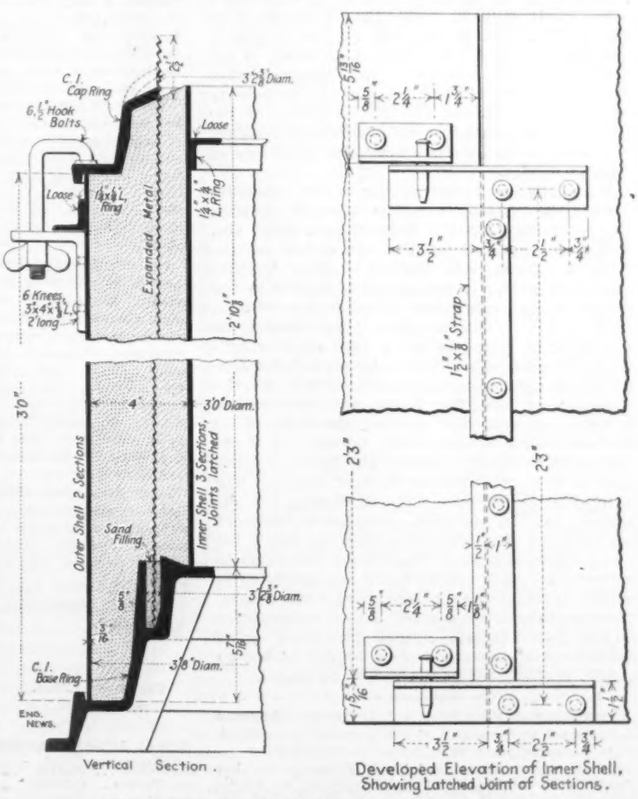

FIG. 3. MOLD FOR 36-IN. LOCK-JOINT PIPE.

Where special requirements make desirable, the bell of the pipe is provided with a short ring of reinforcement, lapped with or wired to the main reinforcement. When this is used, the bell portion is molded of mortar (omitting the gravel).

The joint described is the invention of Mr. Coleman Meriwether, M. Am. Soc. C. E.; the pipe is made by the Lock Joint Pipe Co., 165 Broadway, New York City. The intake conduit for the new high-service reservoir of Baltimore will be furnished by this company. It is to be a 48-in. pipe, with 5-in. wall, reinforced with expanded metal of No. 10 gage, 3-in. mesh.

MACHINES FOR TESTING FLAT-SPOT IMPACT ON RAILS AND RAIL DURABILITY.

A proposal to measure the unknown destructive effect on rails of flat spots on car wheels was made recently by Prof. C. H. Benjamin of Purdue University in a paper read before the Western Railway Club at Chicago. One of the important possibilities of such a machine is that it may give means for fixing an allowable limit for imperfections of car wheels, so that longer life of railway rails may be secured.

The essential parts of the machine are as follows: An axle with two wheels, one of them being the test wheel having flat spots while the other is a good or truly round wheel, is set under a ram which can apply a downward load to the axle through a yoke which bears on the journals of the axle. On the middle of the axle is a pulley by which it can be driven by a belt from a suitable source of power. The good wheel rests on the top of an idler or bearing wheel journaled in fixed bearings; this idler is best made as large as the car wheel, or larger, as its only duty is to support one end of the axle with as little friction as possible. The test wheel, at the other end of the axle, bears on the head of a rail bent to a circle, forming the rim of a horizontal wheel some 7 or 8 ft. in diameter (or as much larger as may be thought desirable). This horizontal wheel can revolve on a fixed pin, and its function is simply to supply an endless track on which the test wheel can roll; the test wheel being fixed in location, the track is arranged to move along under it, by turning about its fixed center pin. The wheel-load is not carried by this track as a whole, but is taken up by a support under the rail directly beneath the test wheel which support also contains the device by which the impact is measured.

This support consists of an anvil on which is a block carrying in its top surface two small wheels or rollers, one ahead of the other, whose shafts are parallel to the axle of the test wheel. The rail track runs on these rollers, so that the load on the test wheel is transmitted to the block. In the bottom face of the block is fixed a hardened ball, and between this ball and the upper face of the anvil lies a strip of soft metal,

arranged to be drawn along under the ball while the track is in motion. A hammerblow of the test wheel on the track will produce an indentation in the soft strip, and by comparing this indentation with indentations produced by known energy of fall in a drop press, the energy of the blow may be measured. To relieve the soft impression strip of the normal wheel-load, so that it may be drawn along readily, the roller-block is fixed to an arm carried by the pier on which the track center pin is supported. This pier is constructed of wood blocking or other compressible material, so that while strong enough to carry the wheel-load easily, it will yield under a hammerblow sufficiently to allow the block to force the ball into the impression strip.

Prof. Benjamin advocates the use of such a machine for practical study of the effect of flat spots on railawy car wheels, to supplement theoretical inferences. An elementary mathematical study of the impact due to a flat spot is easily made, showing that the energy of the blow varies as the square of the speed of train, as the square of the length of flat, and inversely as the square of wheel-diameter. By comparing the results of such a calculation with the drop tests prescribed for acceptance tests of rails, it is shown that the factor of safety of rails under wheel-loads of 20 to 25,000 lbs. at speeds of 60 mi. per hr., with flats of say 2½ ins. length, is not much over 2. The theory, however, is not well able to take account of numerous modifying factors, so that while it indicates the probability of serious conditions, the actual extent of the effect should be studied by experiments designed to reproduce in the laboratory the conditions of regular service.

A machine somewhat similar to the above-described, but having a rather different purpose, has been built by the Pennsylvania Steel Co., and was exhibited at the convention of the American Street & Interurban Railway Association in October. It was described briefly in our report of that convention (Eng. News, Oct. 22, 1908, p. 448). This machine is for testing the durability of rails. It has a fixed circular rail-track mounted on a circular cast-iron girder supported at points equally spaced around the circumference. On the track run two wheels mounted on separate axles at the ends of an arm extending diametrically across the circle and rotated about a center pin by an electric motor. Vertical loads of different amounts can be applied to the arm while it rotates, and the wheels can be pressed horizontally outward against the rails. This simulates the forces between wheel and track in service. The joints in the circular track rail similarly are subjected to impact effects like those occurring under trains. This machine, of course, gives comparative rather than absolute results, the track being constructed to contain a piece of rail of known quality and a piece of the rail to be tested.

LITIGATION OVER MECHANICAL FILTER PATENTS was referred to on p. 548 of our issue of Nov. 19. A fuller statement has been furnished us as follows:

The New York Continental-Jewell Filtration Co. has brought suit against the city of Harrisburg, Pa., for alleged infringement of patents No. 546,738—Reissue No. 11,672 and No. 64,137. The patents in suit relate to the method of and the apparatus for using a down-draft outlet pipe and are generally spoken of as the "negative head" patents. The city of Harrisburg has instructed its Board of Public Works to defend these suits and the City Solicitor, the Hon. D. S. Seitz, has secured the co-operation of ex-Judge M. W. Jacobs, patent attorney, and Mr. James H. Fuertes, of New York, consulting engineer, to the Board of Public Works, Harrisburg.

As the filters at Louisville, Ky., Columbus, O., New Orleans, La., and those of the Hackensack Water Co. at New Milford, N. J., are built in a manner similar to those at Harrisburg, the cities and companies owning the four filter plants resembling the one at Harrisburg have decided to cooperate in making a defense in this suit.

On Nov. 6, 1908, a conference was held at Columbus, O., of representatives of the above mentioned cities and water companies and there was appointed a joint committee to conduct the affairs of the associated cities and companies in cooperating with Harrisburg in making this defense. This committee consists of Messrs. Geo. W. Fuller, Consulting Engineer, 170 Broadway, New York City, Chairman; Theo. A. Leisen, Chief Engineer and Superintendent, Louisville Water Co., 549 Third St., Louisville, Ky., Treasurer; and Geo. W. Rightmire, Patent Attorney and President of City Council, 44 East Broad St., Columbus, O.

The Joint Committee has secured the services of Mr. Allen Hazen, Consulting Engineer, New York City, and Prof. J. W. Langley, Patent Expert, Ann Arbor, Mich. Ample funds have been placed at the disposal of the Joint Committee with the stipulation that the suit shall not be compromised and that if the suit is pressed it shall be prosecuted to a final judgment.

RESULTS OF A TRAFFIC CENSUS ON PUBLIC ROADS IN ILLINOIS.*

There are now in Illinois 71 traffic stations, at which points the number of vehicles passing over certain roads is counted. These stations are distributed in practically every section of the state. There has now been completed one year's record at all stations, and at a number of the stations nearly two years.

RELATION OF TRAFFIC TO POPULATION.—The first investigation undertaken was the relation of the amount of traffic over a particular road to the size of the town in the vicinity of which the road is situated. For this purpose there were selected practically all of the stations which were in the immediate vicinity or on the edge of the towns in question, and the daily average of the number of vehicles passing for a complete year obtained. This average daily traffic was compared with the population. A diagram plotted from the results shows that roads with less than 100 vehicles per day are situated near some of the largest towns as well as near some of the smaller. In general, there is apparently no connection between the amount of traffic and the size of the town towards which the road leads. As in nearly every instance the roads extend into farming country, it would be evident that it is the density of the population in the country and not that in the city which would affect the number of people using a given road and consequently the number of vehicles passing over it.

The conclusion is, that certain individual roads in the vicinity of even very small towns are as important as the roads near larger centers, and as a road's worth is in proportion to its use, a community is warranted in expending as much money on certain sections of roads leading into a small village as on certain sections of other roads leading into very much larger cities.

The conclusion here stated should not be confounded, however, with the idea that there is no greater number of vehicles going into the larger cities than into a small one, for this is not usually true, from the fact that the larger city has a much larger number of roads leading into it. But the fact remains that individual roads into the larger cities may be not (and oftentimes are not) as much traveled as some other roads into much smaller places.

THROUGH TRAFFIC.—To throw some light on the amount of traffic on various portions of a road, comparison of the traffic at those stations located on the same road will be taken. A table of the average daily number of vehicles passing certain stations located on the same road shows that the amount of traffic three or four miles from a center towards which traffic is moving is very much less than close to town. It is evident that a community would be warranted in spending on the first mile or two nearest town, four or five times as much as on sections of the road more remote; then the expenditure would be somewhat in proportion to the amount of traffic.

These conclusions should not be construed to mean that it is necessary to spend four or five times as much; although it may not be as profitable to a community to place as expensive construction eight or ten miles out, as on the first mile. The results do, however, point to the absence of so-called through travel, that is, any considerable amount of traffic from one large town to another, and that the present agitation for construction of such roads, as is stated elsewhere in this report, is premature and is not what the present needs demand.

TABLE SHOWING VARIATION IN AMOUNT OF TRAFFIC AT DIFFERENT DISTANCES FROM A GIVEN CENTER.

Town.	Road.	Distance of station from town, miles.	Average daily traffic, vehicles.	Distance of station from town, miles.	Average daily traffic, vehicles.
East St. Louis.	Falling Springs.	1	122	3½	56
Elgin	Udina	1	182	4½	132
Jerseyville	Fieldon	1¼	117	3½	83
Mt. Vernon	Fairfield	1	156	4½	132
Peoria	Knoxville	2	142	4	72
Rockford	Traskbridge	1	568	1¼	123
Springfield	Clear Lake	1	299	4	67
Springfield	South 6th St.	2½	101	4	60

In comparing diagrams of traffic one is struck in some instances with the great variation in the amount of traffic during the year, and in other cases with its comparative uniformity. This may be explained in part by the varying pursuits in the neighborhood of the various roads on which the traffic is shown. It would naturally be expected to find in a dairy country (where the products must be transported daily) a somewhat more uniform distribution of the traffic than in sections where the pursuits were of such a nature that daily use of the roads was not needed.

On certain days, the traffic was very much less than usual at nearly all stations. These days were usually during very stormy weather prevailing in all sections of the state. At many stations the traffic immediately preceding Christmas is exceptionally large, being occasioned by the Christmas shopping. Usually the Sunday traffic is found to be much less than that of other days at the same time of the year.

TRAFFIC AS THE MEASURE OF THE VALUE OF A ROAD.—A traffic census offers a basis from which to compute how much a road is worth to a community and to determine how much per mile can be spent profitably in the construction and maintenance of roads. Various statistics on this subject have been presented from various standpoints, computing in some instances the tonnage that is hauled over the roads; in other cases, taking the land values as a guide to determine the worth of the road to the community.

A traffic census affords another and perhaps more logical basis of computation, from the fact that such a computation considers exactly the amount a road is used, which reasonably may be inferred as the measure of its value.

Let us first consider two roads having approximately the same amount of traffic, that is, the same amount of good weather traffic during good road conditions. In one instance it is found that for this amount of traffic a community has expended for the construction of a certain stretch of road perhaps $5,000 or $6,000 a mile and has thereafter not only maintained but extended this character of construction. The second road is supposed to be unimproved. With similar occupations in the vicinity of the two roads, it is not illogical to draw the conclusion that if one community found it profitable to spend $5,000 or $6,000, it would be equally profitable to the second community which makes as much use of its road as the first community.

Another investigation as to how much per mile a community might be able to afford, could be undertaken in the following manner: It first is necessary to ask the question how much per mile is a given trip worth. That is, if one has an errand that will necessitate a four-mile journey to town or eight miles for the round trip, how much would he be willing to pay to make this trip over roads in good condition rather than roads in bad condition.

The answer to this question is hard to ascertain, but let us estimate that it is worth 1 ct. per mile. It would therefore be worth 1 ct. for each vehicle that passes a certain point. If there is an average of 100 vehicles a day, this mile of road would be worth to the community, excluding Sunday, $313 per year, or $626 per year for a road averaging 200 vehicles per day. That a cent per mile is well within what one would be willing to pay is borne out by experience in those sections where toll roads are still maintained, and where the charge per mile is 4 or 6 cts. for a two-horse vehicle, and it is seldom less than 3 cts. a mile.

A large percentage of the roads on which the traffic was counted have an average of over 100 vehicles a day. As $313 a year is at least three times, if not four times, what would be necessary to maintain gravel or macadam roads, the conclusion is evident that with the traffic averaging considerably less than 100 vehicles a day, it would, if the use of the road is worth one cent per mile per vehicle, warrant an outlay sufficient to build what are usually regarded as very expensive roads.*

This analysis as to the worth of a road to a community takes into account the use of the road not only for the purposes of hauling, but for social purposes as well. It, therefore, measures more nearly the value of the road than any method which considers only the commercial view point.

*From the annual report of the Illinois Highway Commission for the year 1907. The traffic census system was organized by Mr. A. N. Johnson, State Highway Engineer (Springfield, Ill), and was described in Engineering News, March 21, 1907.

*This comparison to be accurate should include the interest on the cost of macadamizing as well as the cost of a mile of macadam road at $6,000, the interest charge alone at 5% will be $300 per annum. Either a larger average value than 1 ct. per mile per vehicle must be assumed therefore or else it must be concluded that a traffic considerably in excess of 100 vehicles per day must exist to justify improvement.—Ed.

THE BOSTON AND EASTERN RY is brought to the front again in the long-expected decision of the Massachusetts Board of Railroad Commissioners which was announced Nov. 18. The effect of the decision is set forth in two paragraphs which we quote:

The statute of 1906 authorizes after appropriate proceedings the construction and operation of electric railroads. The first step in these proceedings is an adjudication that public conveniences and necessity require the construction of a railroad of this character, and the board finds that such public convenience and necessity have been shown and that the general plan as now developed by the petitioner will afford the additional facilities demanded in the densely populated territory north of Boston.

It is agreed, however, by all parties before us that no certificate of exigency so called should issue at this time, for the reason that the scheme as a whole contemplates a service by means of a tunnel and subway not authorized by existing law, and that in order to make this decision effective the petitioner must have recourse to the General Court.

The report was signed by Walter P. Hall and Geo. W. Bishop as Commissioners. The third member of the board, Mr. Clinton White, did not sign it.

ENGINEERING NEWS

A Journal of Civil, Mechanical, Mining and Electrical Engineering

Published every Thursday by

THE ENGINEERING NEWS PUBLISHING CO.

220 BROADWAY, NEW YORK

BRANCH OFFICES

CHICAGO: 1636 Monadnock Block
WASHINGTON, D. C.: Home Life Building
ATLANTA: Candler Building
RUDOLPH MOSSE, BERLIN AND HAMBURG, GERMANY
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Entered at the New York Post-Office as Second-Class Matter.

The purchase of electric current from the Commonwealth Edison Co., of Chicago, by the electric railway companies of that city, was noted briefly in our issue of Oct. 29. We have since obtained further particulars of the method used in determining the rate to be paid for current by these railway companies. In the first place, the electric power company recognizes that the railway companies, by virtue of the high load factor of their business, are entitled to an exceptionally low rate for power, and that the higher the load factor, the lower the rate which the power company can afford to make to them. The latter company, therefore, enters into a contract with the railway company for the sale of power at the very low rate of 0.4 ct. per KW.-hr., and includes in the contract a condition which virtually penalizes the railway company in proportion as it does not use the power at an even rate during the 24 hours.

This penalizing is done by charging the railway company at the rate of $15 per KW. per year for the maximum draft which it has made at any one time. Thus, if a railway company should use say 10,000,000 KW.-hrs. a year at an even rate day and night throughout the entire period, the average load would be, say, 1,138 KW. It would pay for its power for the year as follows: 10,000,000 KW.-hrs. at 0.4 ct., $40,000; 1,138 KW. of station capacity at $15, $17,070.

It is impossible, of course, for the railway to use current at anything approaching an even rate, the traffic conditions causing an enormous variation in demand. The peak of the load during the rush hours of the morning and evening is far in excess of the draft during the middle of the day, while there is a very slight draft between midnight and 5 a. m. In the case of Chicago, the maximum draft is about double the average draft, on a year's business. Supposing, then, that the railway used the same amount of power as above, but that it had at some time used the power at double the average rate. Then the bill for current would be figured as follows: 10,000,000 KW.-hrs. at 0.4 ct., $40,000; 2,276 KW. of station capacity at $15, $34,140.

For the purpose of determining the maximum demand for power which the railway company makes at any one time, the day is divided into two equal parts; midnight to noon, and noon to midnight. The maximum amount of current furnished during any one hour of each of these two halves is averaged together, and is called the maximum for the day. It is based upon the average for the highest hour, and not upon the actual maximum reached by the peak of the load. The figures of the daily maximum for consecutive days are averaged together, and the highest average for any three consecutive days of a period is called the maximum demand for that period. Upon this maximum the $15 charge is based.

We present to our readers in this issue the first authoritative account of the remarkable oil well near Tampico, Mexico, concerning whose antics many lurid stories have recently been going the rounds of the newspapers. Mr. Floy, the author of the paper, makes it clear that most of the newspaper statements were wild exaggerations. The real facts regarding this well, however, are remarkable enough to deserve general attention.

If there be any other case on record where the drilling of a well has created a veritable geyser through the erosion and enlargement of the hole by the issuing stream, we have never heard of it.

In the discussion of the construction of reinforced-concrete freezing tanks at the annual meeting of the American Society of Refrigerating Engineers, noted on another page of this issue, it was stated on the floor without contradiction that, provided conditions were such that continuous construction could be carried out, it would be perfectly safe to build in an integral section 100 ft. long a plate-ice tank of concrete, amply reinforced. In view of the experience with reinforced-concrete retaining and reservoir walls which, though under moderate ranges of temperature, generally crack at intervals of from 50 to 75 ft., unless provided with expansion joints, it seems hardly good practice to recommend the construction of freezing tanks, under large temperature ranges, for any length above 50 ft. without some opening for expansion. The very nature of these tanks, made up as they are of numerous smaller boxes, makes very easy the building of a double wall at every 50 ft. and avoids the necessity of the extra heavy reinforcing against temperature stresses, a reinforcement that is at least of doubtful value for extreme lengths.

A project is under discussion in Pennsylvania for the building of a macadamized road clear across the State, or from Philadelphia to Pittsburg. Similar projects for creating through lines of communication over macadamized roads are under discussion in other States. In considering any such project, it might as well be recognized that the real beneficiaries from any such through road, taken as a whole, are the automobile tourists.

It needs no demonstration to prove that horse-drawn vehicles on a highway, no matter how improved, do not and cannot compete with railway trains for long distance traffic. The question of through highways, therefore, becomes simply a question as to how much the State ought to expend for the benefit of pleasure tourists.

In a State like Massachusetts, where highway improvement has already been carried out on a large scale, it is certainly reasonable now to complete short links between the different networks radiating out from the larger cities. In many cases, by building comparatively short stretches of improved road, a through line of communication will be completed. These short links will have some value, of course, to the locality where they are placed, in addition to their value as links in the through line.

On the other hand, since in every State the mileage of improved roads which can be built is strictly limited, the roads which have the greatest claim to consideration are those which have or can attract the greatest volume of traffic, and these are the roads in the vicinity of the centers of population and not the through lines.

An interesting highway traffic census has been carried out in Illinois by Mr. A. N. Johnson, State Highway Engineer, and is described on another page of this issue. This investigation revealed that the bulk of traffic on common roads is of vehicles going to and from the towns and villages. Comparisons with the amount of travel on a road at points one mile, two miles, three miles, etc., from a given center, shows a very rapid falling off with increasing distance from the town. In other words, there appears to be very little traffic over the highways from one large town to another.

Of course this result of the traffic census is exactly what would be expected by any one from mere general knowledge of conditions. Horse vehicles on the highway are too expensive and too slow to carry either goods or passengers from one town to another, 15 miles or more distant, if railways are available. The bearing of this fact upon the proposal to build state and interstate through highways is evident. Automobile traffic, and automobile traffic alone, will be the only justification for such through highways, considered apart from the local traffic which they will serve along the line. It is doubtful whether the general public is yet ready to be taxed to build through highways for automobiles.

IS MR. TIMOTHY WOODRUFF TO BE THE NEXT STATE ENGINEER OF NEW YORK?

Who is to be the State Engineer of New York after Jan. 1? Mr. Frank M. Williams was elected to that office by the voters of the State on Nov. 3, but if we may believe the newspapers, another man has now been brought forward by the Republican political leaders and announced as ready to discharge the duties of Mr. Williams' position. The "Sun" of Dec. 5 contained the following remarkable item:

> There was a conference of New York State Republicans at the Republican Club in East 40th St. yesterday. Only state officers-elect or their proxies or personal representatives and Republicans connected with the organization in whose territories the coming state officers lived were present at the conference. At the close of the conference there was no disposition to speak of what had occurred, but finally this statement was authorized:
>
> "The conference held at the Republican Club to-day was for the purpose of cementing the harmonious relations which exist between President-elect Taft, Secretary Root, who is to be elected United States Senator in Mr. Platt's place, and Chairman Woodruff of the State Committee, who is to remain State Chairman for the next two years. Under no circumstances will Mr. Woodruff accept any appointment. He is to remain head of the State Committee, and the State officers-elect and their representatives have come to an agreement that *Chairman Woodruff is to be the clearing house man through whom all appointments are to be made* to the State Departments of Comptroller, Secretary of State, State Treasurer, Attorney-General and *State Engineer and Surveyor.** Those present at the conference to-day are to make no requests of Gov. Hughes for appointments."
>
> All Republicans connected with the organization, it was declared, are to be recognized in all ways, including patronage and measures, in order that the maintenance of harmony in the state organization for the next two years may be made as perfectly as possible.
>
> Influential Republicans who took part in the conference insisted that its only purpose was to bring the organization up to a greater efficiency and into greater accord with the Taft administration, and also the recognition of Chairman Woodruff, head of the state organization, through whom all recommendations for appointments in the state departments at Albany must pass.

Such frankness is refreshing. It helps the voters of the state to know where they stand. They will be interested without doubt to know that the hundred million odd dollars which they are laying out on the barge canal is to be expended under the direction of men selected under the expert guidance of Mr. Timothy Woodruff. Of course with his broad knowledge of engineering and engineers he will select men of professional ability and experience, and above all of unimpeachable integrity; engineers who can be relied upon to hold a contractor to the requirements of his agreement and protect the state's interest no matter what political pull the

*Italics ours.—Ed.

said contractor may possess. Of course that is what is meant by "patronage" and "building up the organization" in the above quotation.

The office of State Engineer of New York is one of great importance. Candidates for it ought to be men of large professional experience and high reputation—engineers of as high rank as would be selected for similar large responsibilities by a private corporation. A few incumbents of that office in the past have measured up to this standard; but more, we regret to say, have ranked far below it. And this will continue as long as the office of State Engineer is filled by popular vote. If a newly elected State Engineer owes his nomination to the party boss who happens to be in power, he must be a man of unusual backbone if he disregards political pressure in making his appointments.

We know nothing derogatory to the newly elected State Engineer of New York. He is a young man suddenly promoted to a high office which gives him a remarkable opportunity to make for himself a reputation. We have no knowledge that he is a party to the agreement above quoted, that appointments of his deputies and subordinates are to be made through the Republican State Chairman.

In the interest of the people of the state and of sound and economic engineering, we venture to express the hope that the new State Engineer may disappoint his would-be bosses. We hope that Mr. Williams may prove to have the ability and the firmness to be himself the State Engineer. We hope he may follow true professional standards and carry out unswervingly the spirit of his oath of office. If he does this—if he sticks to efficiency, honor and honesty as the sole criterions by which to select his subordinates, he will not only protect the interests of the public but will render better service to the party that nominated him than could possibly be rendered if he were to relinquish the chief responsibilities of his office to Chairman Woodruff.

Whether he does this or not, however, the lesson as to public policy is plain. The State Engineership of New York or of any other state, as we pointed out editorially a month ago, ought to be an appointive instead of an elective office. We shall draw some blanks of course in high positions even then; but we shall stand much better chance of placing efficient men in positions demanding expert ability than under the system where nominations to such offices are made by a party boss.

WHAT ARE FLYING-MACHINES GOOD FOR ?

At the meeting last week of the American Society of Mechanical Engineers, two sessions were devoted to papers and discussions on recent developments in the art of aeronautics. One of these, prepared by Major George O. Squier, of the Signal Corps, U. S. A., we publish in this week's issue. Major Squier's paper is by far the best general review of the progress up to date in this new field of engineering that has appeared anywhere. That the subject is of great popular interest was evident at the meeting on Wednesday evening, when a popular lecture on the subject, by Lieut. Lahm, was presented. The large auditorium in the Engineering Societies Building was filled to overflowing—the first time, in fact, that it has been so filled since the Engineering Societies Building was opened.

Major Squier's paper is, however, of more than popular interest. In the recent development of the flying-machine, the methods of the engineer have been substituted for those of the inventor. Important investigations have been made and constants worked out with reference to the resistance of air to the motion of a body through it, and the skin friction of bodies in air. Some of these data are likely to prove useful in other fields than aerial navigation.

And now, giving full credit to Major Squier for his interesting and valuable paper, it seems desirable to point out the limitations that seem likely to set a hard and fast restriction upon the development of aerial navigation. We are well aware that the tendency in current publications is all the other way. The recent successes of the Wright brothers and of Farman and Zeppelin are currently compared to the successes of George Stephenson with his early locomotives; and the general public is ready to believe that as great development in aerial locomotion is to take place in the future as the last three-quarters of a century has seen in the field of locomotion on land. The engineer, however, familiar with the hard and fast limits set by the strength of materials and the possibilities of power development, can appreciate, as the layman cannot, how small are the probabilities in aerial flight.

It has seemed well, therefore, to present in these pages a word of caution to the sanguine inventors and investors who are likely to exaggerate the commercial possibilities in this field, just as the commercial possibilities of liquid air were exaggerated a dozen years or more ago. Every new scientific discovery that particularly appeals to popular interest is taken advantage of by fakirs to float stock and swindle credulous investors. Only a few weeks ago it was announced in the newspapers that a company had been incorporated to operate a line of freight and passenger air-ships between Boston and New York. Undoubtedly there will be plenty of such companies advertised within the next few years. We may expect also that companies to build and to sell and to operate new types of flying-machines will be seeking stock subscriptions in every city in the country. It is well, therefore, to ask the practical question, what the flying-machine is good for commercially.

So far as the possibilities in freight transportation are concerned, it may be passed with a word. Wherever ordinary methods of transportation on land are available, it will be absurd to carry goods of any sort through the air. The cost of such transport would be measured not in mills per ton mile, as in rail or water carriage, or cents per ton mile, as in wagon haulage, but in dollars or hundreds of dollars per ton mile. It is true that for exploration in difficult country, as over the Arctic ice or in rough mountain regions, there are possibilities in the air-ship. But such use, of course, is rather scientific than commercial.

For the carriage of passengers, the necessary risks attendant upon flight through the air, either with the dirigible balloon or the aeroplane, are certain to limit passenger traffic to the field of sport and amusement. This is, of course, a much more considerable field than is often realized. The public is willing to pay very high prices for mere amusement, and it is altogether probable that a few years hence aeroplane flights will be a drawing card at county fairs and other public occasions, just as ordinary balloon ascensions have been for a century past. The experience of the high-speed automobile, too, has proved the existence of a very large leisure class of wealthy men who find vent for their surplus energies in undertaking all sorts of risky exploits. Flight through the air may very likely become as popular a fad a few years hence as automobile racing is to-day; but it will have just as little relation to the serious, practical, every-day business of carrying freight and passengers for the great workaday world, as have the hundred-horsepower automobiles that break speed records in France or America.

But the promoter of an aerial navigation company who is seeking to unload his stock on a confiding public, is sure to bring forward the argument of government patronage. Major Squier's paper, unfortunately, we believe, declares that the flying-machine is to play a most important part in future warfare. We took strong ground in opposition to this idea in an editorial published some months ago,* and notwithstanding the claims made by Major Squier, we see no reason to alter the position then assumed. It is said that the leading military nations are vying with each other at the present time in the development of military air-ships, but this does not prove that these structures can be made practically useful in the serious business of actual warfare. Major Squier truly says that we can only theorize concerning this matter, since no practical use of air-ships in warfare has yet been made; but enough is known of the possibilities to enable us to theorize with fair accuracy.

Of all the apparatus ever proposed for use on the battle-field, a flying-machine is beyond all question the most vulnerable. It offers an ideal mark to the bullets of the enemy. The limitations of weight forbid its protection by any sort of armor. Had the flying-machine been developed 40 or 50 years ago, when projectiles were limited to small velocities and short ranges, it might have performed some service in observing the enemy's forces; but with modern infantry rifles discharging projectiles with an initial velocity of 2,700 ft. per second, and with light artillery fitted to discharge a perfect hailstorm of bullets having equal velocity and range, the rise of an air-ship at any point within several miles of a hostile army would be nearly the signal for its immediate destruction.

Major Squier in his paper makes the surprising statement that air-ships at a height of one mile would be safe from the enemy; but the bullet from an infantry rifle will rise to an elevation of a mile in little more than two seconds. The sharp-shooters in an army would enjoy nothing better than the opportunity of taking pot-shots at the unfortunate navigator of any air-ship which might appear above the horizon. Major Squier argues that at night an air-ship might approach within a few hundred feet of a hostile army with comparatively little danger, but there are few nights so dark that either an aeroplane or a dirigible balloon would not be plainly visible to an enemy's pickets. If, perchance, the night was so black or the fog so thick that an approaching air-ship could not be perceived, then the air-ship would be unable to either gain any information or to find any point where it might desire to do damage.

Major Squier suggests the possibility that an air-ship might sail over a battle-ship and drop explosives upon it, and might likewise do injury to dry-docks, arsenals, ammunition depots, etc. It must be remembered, however, that the destructive effect of high explosives extends over a very small radius; and, as already pointed out, the air-ship would have very small chance of reaching its objective point before it would be destroyed by some hostile shot.

There is, however, one possible field of usefulness for the aeroplane, should it be developed to be reasonably reliable, which seems to have some promise. This is the bearing of dispatches across friendly territory. It is doubtful whether the dirigible balloon, with its enormous bulk and the vast amount of material required to handle it, could be of any practical service to an army in the field, even within its own lines. If, however, an aeroplane can be developed which can ascend and alight at any desired point, it might be made use of to carry messages back and forth between the posts of an army operating in the field.

We have deemed it a duty to make these comments upon Major Squier's paper, to offset in some degree its possible misuse in the future by those who engage in the development of aerial navigation from the commercial instead of the scientific point of view. Safe advice to give to the would-be inventor of or investor in an air-ship is: "Don't."

*Engineering News, July 30, 1908, p. 126.

LETTERS TO THE EDITOR.

Calculating the Intersection of Any Two Grade Lines.

Sir: The letter of Mr. Arthur J. Rector in your issue of Nov. 19, p. 563, in which he gives a formula for the calculation of the intersection of any two grade lines, seems to me to be one of a numerous class which apparently seeks to involve perfectly simple operations, generally relating to curves and grades on railroad work, in a certain amount of mystery.

Of course his formula is a comparatively simple one, but nevertheless it is more involved than is necessary. The method commonly used by locating engineers, and which they use almost as mechanically as the multiplication table, is that shown below, and the only thing one

has to remember is that in all these cases one grade is to be produced to a point opposite the end of the other grade, the remaining operations then being perfectly obvious.

In the first case (Fig. 1) the +0.4% grade is produced to Sta. 450 giving an elevation at point A of 740; the difference between this elevation and the elevation of the grade at Sta. 450 is 28 ft.; this divided by the algebraic sum of the grades taken from the ends towards the center which is 1.4 gives the distance in stations (20) from A to the point of intersection.

In the case of two ascending (or descending) grades of different rates the principle is the same, as for example

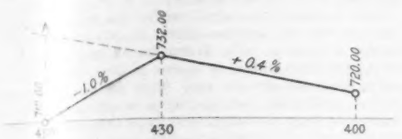


Fig. 1.

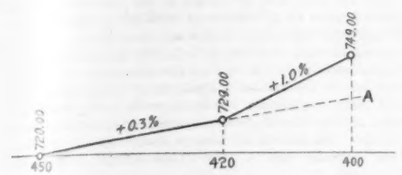


Fig. 2.

In Fig. 2, the elevation of A is 735 and 749 — 735 = 14. Algebraic sum of grades, from ends towards center (+0.3 — 1.0) = —0.7.

14 ÷ 0.7 = 20. = distance (No. of stations) from A to point of intersection.

As a matter of fact on the location of new lines, where the rates of grade can generally be fixed at the nearest even tenth of a foot per cent. and where the breaks in the grade should always be fixed at an even station, the point of intersection can be generally fixed graphically on the profile paper without resorting to any computation.

There are still a few engineers who endeavor to give their profiles an appearance of great refinement by using grades with rates expressed to hundredths and even thousandths of feet per cent. and break their grades at odd stations. When the uncertainties as to what the construction will develop, and the changes invariably made before the roadbed is ready for track, are considered, however, it should be realized that these refinements are useless and involve not only time wasted in fixing them, time which the locating engineer should be ill able to spare, but also many hours to the construction engineers, which generally involves their sitting up into the small hours of the morning, and seldom if ever benefits the line by cheapening its cost.

Yours very truly,
F. Lavis, M. Am. Soc. C. E.

134 Elm Ave., Mt. Vernon, N. Y., Nov. 21, 1908.

[The simple solution given above has also been submitted by Mr. F. L. Gilbert, of Detroit, Mich. The problem is in fact too easy to warrant the complication of a quadratic equation or even of any set formula whatever. The simple geometrical relations, as explained by Mr. Lavis, give the solution without delay.—Ed.]

River Improvement: The Continuous Woven Mattress Revetment Compared to the David Neale System.

Sir: The writer had not considered the "David Neale System of Bank Protection" worthy of serious consideration as a work of permanent river regulation until the appearance of an article on the subject in your issue of Oct. 22, 1908, by Mr. Charles H. Miller, Engineer of River Protection, Missouri Pacific Ry. But when that flimsy system is proposed for general use, to curb the mighty Missouri, it is thought high time to bring out the points of this system in comparison with the continuous revetment, so that anyone interested in bank protection may stop and think before expending money in a manner that is worse than useless whether he be a railway official trying to protect railway tracks, or a farmer making a desperate effort to save his little home.

The writer is not prejudiced in any way and would be ready at any time to endorse and adopt any method of bank protection that could be devised to do the work as well as continuous revetment, for less cost than that work. During 20 years of service he has seen hundreds of thousands of dollars spent in a desperate effort to find some means of protecting banks at a lower cost than that of continuous revetment. But all experiments along this line have failed, and it is now conceded by thinking men that the continuous revetment is about as near permanent protection as can be obtained at reasonable cost.

Continuous Revetment.—This type of work was fully described by the writer in an article in your issue of June 5, 1902, but a short description follows:

The bank is first graded to a slope of 1 on 2 or flatter, and this should be done in extreme low water to get good results. Then a mattress, made of ordinary willow brush, is woven, strengthened by a system of wire cables. This mattress is about 12 ins. thick and 75 to 100 ft. wide. It is sunk to the river bed by being ballasted with one-man stone, the inner or shore edge of the mattress being at the foot of the graded slope. Spawls are placed just above the shore edge of the mattress in sufficient quantity to fair up the slope and to prevent surface wash under the mattress.

The slope is then paved with one-man stone from the top to the water surface, each stone being set up by hand. This work is carried from the top down the slope rather than from the bottom up the slope, so that when finished, the stones will be slanting up hill. Thus they will catch any sediment brought in by waves, and also will be self supporting. This paving has a depth of about 12 ins. Below the water surface a layer of one-man stone is cast on the mattress until a contour below any possible low stage of river is reached. On top of the paving, a layer of spawls is cast and thoroughly raked in, filling all voids and cementing the surface, making it impervious to attack.

This, in a few words, is continuous revetment. When the work is properly done, a ragged, ugly bank, inviting eddy action and destruction, is changed to one of straight lines and gentle curves, along which the current flows serenely and peaceably, all fight taken out of it. A brick house can safely be built at the top of the slope, and the inmates nightly lulled to sleep from the cadence of the wave action along the stable rocky shore.

To be properly done, the work must commence at the head of a bend (generally at a rock bluff contact) and extend to the foot of the bend, beyond any attack of the river. In this way the ends are protected and in the body of the work there is only a solid rock surface exposed to attack.

This work has been done at a minimum cost of $6 per lin. ft. of bank protected. A trip over the river will show Mr. Miller miles of it that is anywhere from 5 to 25 years old. Mr. Miller states that his experience with this class of work has not been so favorable as that of the army engineers. And why? Simply because the work was not properly done. Generally, only a short piece was put in and that possibly right in the bight of the bend; and possibly the mattress was put in hurriedly and not properly sunk to a good contact with the river bed, so that destruction commenced even before the contractor could get his money and get away. Then the only report made was to the effect that revetment was tried and failed.

Mr. Miller quotes from my statement to the Inland Waterways Commission that my estimate of plant for this work was $27,000, including pile driver. He got the figures right, but is entirely in the dark as to the meaning of my statement. The plant, costing $27,000, was proposed to carry on all classes of work on a 100-mile stretch and to complete work in that stretch in five years. He failed to quote the paragraph which states that the matress could easily be woven on a raft costing $100.

The David Neale System.—What is it? A few bundles of brush and brush-cribs anchored to the bank in spots, weighted down with rock, and projecting out into the stream. This spur dike of brush at once forms an obstruction to the current, and this creates head, and head creates velocity. The water-surface above the dike being higher than that below, the water makes a desperate effort to seek a lower level. It whirls around the end of the dike, creating a destructive eddying whirlpool above and below, and in a little while the bank is caving rapidly on each side of the dike, worse than before the dike was built. A little later the dike is cut on a point connected with the main land by a neck of sand. Finally, the water makes a mad rush through this neck of sand and, like a monster devouring its prey, the river literally gobbles up the dike, and it is no more.

From Mr. Miller's statement this work costs $5 per lin. ft. of bank protected. Which is the cheaper work? It is certainly not difficult to decide.

Mr. Miller also speaks of this system of work as being carried on in the improvement of the Missouri River. The only work of this nature on the Missouri River is that done by the Missouri Pacific Ry. (with which company Mr. Miller holds the position of Assistant Engineer), and that done by a few farmers induced to try it by Mr. Miller.

This work "looks good" to the farmer, first on account of its cheaper first cost. Then one, two or three dikes are built at the head of a bend where the river smiles by them in a placid mood. One month, two months, three months roll around and they are still "protecting" the bank as the farmer timidly approaches the river, day after day, and peeps over the bank. This gives him confidence and he proceeds to mortgage his farm to build a few more dikes down in the bend, and gets his neighbors to help, and thus save hundreds of acres of fine bottom land. But the old Missouri is hungry and has just left those piles of brush under that rock point as a bait to the farmer, and can hardly wait to get busy. More dikes are built down in the bend and when the farmers have put up all their spare cash, a rise comes along and the feast on brush dikes begins.

If this is not the case, why did Mr. Miller build continuous revetment between his brush dikes at Marion Station, and why did he have to move his tracks back from where his brush dikes were built at Sandy Hook?

The subject of bank protection is well worth consideration by river engineers and he that devises a method at a much lower cost than that of continuous revetment will have made his fortune as well as conferred a lasting benefit on the country at large, but it is a waste of time and money to go back and try all over again, experiments that have proved failures.

W. R. De Witt,
U. S. Assistant Engineer.

Kansas City, Mo., Oct. 29, 1908.

[A proof of the above letter was submitted to Mr. Miller and we append his reply.—Ed.]

Sir: In presenting the article on river improvement work which you published in your issue of Oct. 22, 1908, it was the aim of the writer to bring out discussion of the David Neale system, and on this account he wishes to thank Mr. De Witt very much for his efforts in that direction, although the criticism is not up to the standard of excellence that would ordinarily be expected from one engaged in river work.

The first supposition is that the critic is strongly prejudiced, but he states that he is not in any way, and this is accepted as the truth. The next supposition would naturally be that he lacked experience and opportunity to know the facts about river work in general and the Missouri River works in particular; but he states that he has had 20 years' experience. This forces us back to the last stand, and that is that the facts do not bear out his claims, if, as his discussion seems to indicate, he is endeavoring to prove the correctness of his statement before the Inland Waterways Commission to the effect that continuous revetment or mattress when properly constructed will ordinarily stand for 20 years with very little or no expenditure for maintenance.

After reading the sixth paragraph of Mr. De Witt's letter you are inclined to believe that if you once get continuous revetment, the balance will be "one grand sweet song;" and you are very much tempted to take just one glance out of the back door and down over the slope to see if you can not observe mermaids dancing to "the cadence of the wave action along the stable, rocky shore." Your thoughts are almost wafted heavenward by the sweet strains!

An examination of the Century Dictionary discloses the fact that the first definition given after the word "cadence" is, "A fall, a decline, a state of falling or sinking." Now this is not mentioned to break up the harmonious chords of my brother engineer, but merely to explain my mention of the back door in the previous paragraph, having had in mind the general superstition that it is bad luck to leave a house by that door; and that if the wrong kind of a "cadence" came along, the foolhardy individual that built his brick house in such a location, would be unable to leave through the lucky exit, without taking chances regarding his personal safety.

Having before me your issue of June 5, 1902 in which Mr. De Witt "fully described" continuous revetment, the following is quoted from the paragraph describing the hydraulic grading:

> With a pressure of 100 lbs. per sq. in., this outfit throws a cutting stream that grades the bank, throwing all surplus material out into the current which carries it away, and leaves the sloped bank in the rear as true and smooth as if a plane had passed over it. The grading force at work, and the manner of handling the stream of water are shown in Fig. 3.

This figure referred to is a reproduction from a photograph, and it also shows some graded slope that is not "true and smooth"; and thoroughly corroborates the experience of the writer on a similar class of work on the Mississippi River, where we generally found it necessary to do considerable dressing of the slope with shovels, and at times with teams and scrapers, after the grader had left it.

The writer has not made any extended trips over the Missouri River, partly because of the uncertainty of being able to take passage on a boat at any regular time (in fact there are very few regular through, or even local, boats plying on that stream, and these run only during a part of the year), but mainly because there are one or more good railways on each side of this river. Between 1884 and 1903 the Government expended $7,325,000 on the improvement of this river (see Report of Chief of Engrs., U. S. A., for 1903, p. 406). A large part of this money, however, went into the protection of harbors and other local interests, and did not directly benefit navigation.

An apology is due from the writer in not clearly stat-

ing upon what extent of experience he based his conclusions; and the sentence in the original article was at fault in this particular. What he really meant was that from his long experience with the U. S. Engineers in building mattress work on the Mississippi River, he had not noted the good results as to permanency that were claimed by Mr. De Witt for the Missouri River work. A careful reading of the part of the article just following would, however, throw some light upon this point, which no doubt was missed by Mr. De Witt, for otherwise he would hardly have made such positive statements in the closing of his eighth paragraph. All of the work referred to was built by Government forces under approved plans, and none of it by contract.

Let us now examine into the record of continuous revetment work on the Missouri River as it is published in the various annual reports of the Chief of Engrs., U. S. A., which are usually abstracted from the reports of the several Assistant Engineers in charge of the work at the time. Is it possible that Mr. De Witt has forgotten these reports? We brief from the report of Asst. Engr. W. R. De Witt to Major H. M. Chittenden as shown in the annual report for 1905, page 1698, as follows: (Note.—The annual report for any one year covers the period from July 1 of the previous year to July 1 of the year mentioned.)

Omaha—Repairs to revetment, $2,458.79; Nearman Bend—Repairs, $959.91; Murray Bend—This revetment showed a stretch of 1,800 lin. ft., beginning at a point 1,000 ft. below its head and extending down stream, of upper bank work that was beginning to disintegrate. Temporary relief was had by placing 682 brush and rock fascines at a cost of $3,655.93. It is a question of only a short time when this revetment must either be rebuilt or protected with pile dikes; St. Aubert Revetment—Built in season of 1895 to 1896, slightly damaged by having a pocket gouged out of upper bank, 110 brush and rock fascines placed at a cost of $663.34.

From the annual report of 1904, page 2313, we abstract the following:

Murray Bend—The work in this bend, 10,117 ft. of revetment, was badly damaged by the 1903 flood, 1,300 ft. being scoured out at the head and the bank badly scoured out back of the revetment at three points near the foot. 775 fascines 4 ft. in diameter, 16 to 20 ft. long; and 3 fascine dikes of total length of 350 ft., were built at a cost of $6,017.37. St. Aubert Bend Revetment—In good shape except at foot where it was rapidly being destroyed by eddy action, a fascine dike was built at a cost of $676.70. (Above was reported by Mr. De Witt.)

In the report of 1903, p. 1562, U. S. Asst. Engr. S. Waters Fox, after an examination of the works in the St. Joseph reach on July 18, 19, reported as follows regarding the conditions:

Bon Ton Bend—A breach in the revetment 2,500 ft. (estimated) in length in the locality of 5,000 to 7,500 ft. below the head of the work. Belmont and Elwood Bends—A breach in the Elwood revetment 600 ft. in length (estimated) in the locality of 3,500 to 4,100 ft. above lower end of the work. Below St. Joseph—Revetment and dikes in good condition.

In the Supplement to the Annual Report for 1902 and in the report of the Missouri River Commission is given a brief description of works built under the direction of the Commission since July 5, 1884; from which, and under the locations mentioned, the following quotations are made, beginning on p. 194:

Sioux City, Iowa—The revetment of 1889 and 1890 proved efficient until the high water of July, 1898, when, from flanking at the head, about 2,700 ft. of it was washed out, the bank thus exposed was covered by the railroad company, whose roadbed it protected; another break of about 1,000 ft. at the foot of the first break, occurred during the spring flood of 1899, this break was also covered by the railroad company.

Rulo, Neb.—Under a specific allotment of $50,000 in the Act of Aug. 11, 1888, made by Congress from the general appropriation for the river, the bank at the head of the bend was revetted for a distance of 4,922 ft. (No other funds were available until the sundry civil act of June 6, 1900.) At this time the first revetment had been entirely destroyed by flanking, and the bank, which it had protected, had receded from 500 to 1,400 ft.

St. Joseph, Mo.—These revetments have received a large amount of repair work and renewals, and at the present time stand in need of a considerable amount of repairs; but they have been and are effective in preventing a cut-off in the river. . . .

There are other instances mentioned wherein the continuous revetment has had to be repaired extensively in order to hold it effective, but it is useless to take up more space with additional examples, and these citations will end with calling your attention to Fig. 1 in your issue of June 5, 1902, whereon is shown at the left-hand side of the figure: "Government Revetment Built in 1881." This must have been entirely destroyed to have permitted the building of the willow mattress in 1889 at a location 500 ft. and more behind the location of the 1881 revetment.

It is only fair to say that there are other instances showing more favorable results than the ones cited; and all that the writer wishes to prove by the above quotations is that the continuous revetment is not permanent work. It is fair to presume, however, that the reports published are favorable reports in so far as the facts will permit. He is firmly of the opinion, based upon a personal acquaintance with many of the officers and men in charge of the same, that the work accomplished was full value received for the money expended in accordance with the best plans in vogue at the time, and had funds for repairs been available at the proper time, very much that was eventually lost would have been saved, effective.

It is not claimed that the David Neale or any other intermittent dike system will not invite eddy action, and will not show a more ragged bank than when continuous revetment is placed; but a great part of this difference in appearance is due to the fact that the entire upper bank (the only part that can be seen) is graded off and nicely paved above the revetment or mattress work; while with the dike system most of this part of the bank is not touched. The part of the bank below the low water line is not changed to any appreciable extent when building revetment, and as the river banks in their natural condition consist of pockets and points, it is fair to presume that if you made a trip over the river and examined the continuous revetment works now in place, you would find many eddies and projecting points within the limits of the revetments.

To be properly done, revetment should be commenced at the head of a bend, and continued to the end of the same, beyond any attack of the river, as is stated by Mr. De Witt; but the roadbed of the railway is usually attacked at a point where the caving is very active, which is always some distance below the head of a bend. And if, as was the case at Marion Station, Mo., the caving extended right up to the ends of the ties (on an embankment 10 ft. high) with the river at bank-full stage and strong eddy with a depth of over 50 ft. of water at a distance of less than 100 ft. from the track, before protection work was started; we know of no possible way in which continuous revetment could have been placed in a short enough time to have saved the remainder of the embankment, as was done by the use of the David Neale system.

And let me call your attention to a more recent occurrence, viz., at Pine Bluff, Ark., where during the present month the costly court-house and a fine and expensive hotel were saved from destruction by the use of this system in checking the caving by the Arkansas River, and this, too, while the Government fleet was being hurried to the point to put in protection work. It is the combined evidence of all that were engaged in this work that under the extreme conditions and great emergency it would have been impossible to have placed any other system of protection in the short time left to save the above-mentioned property. Later on the river again attacked very severely, additional fascines were placed, the bank in front of the fine hotel was thoroughly secured, but the loss of some 20 ft. or more at the Court-House further down stream has permanently endangered the annex to the same; below this the caving has progressed quite rapidly and much valuable property has been lost. The problem was of such magnitude that it was impossible to hold, or even attempt to hold all of the caving. It is only fair to add that because of the cutting off of a point in the bank opposite the city, the severe attack moved down stream gradually, thereby relieving the pressure immediately in front of the hotel during the latter days of the flood. There is no shadow of a doubt but that this property would have gone into the river except for the David Neale system. The Government fleet has arrived in the mean time; but it was a physical impossibility to build and place any mattress work under the severe conditions obtaining; in fact their snag boats (being of the usual size for such boats on this river) were unable successfully to stem the current at times; and the officers in charge displayed good judgment in removing these boats to a place of safety, and in turning all their forces and energies into the construction of the fascines.

The comparison made regarding the cost of the different systems is not a fair one. Although it is true that continuous revetment has been placed at a minimum cost of $6 per lin. ft., that price was obtained several years ago, and when labor and materials were much cheaper. We note that the U. S. Engineers in estimating this work usually do so at $10 per ft. The best bids the railway company has been able to get range from $8 to $10 per lin. ft. And on work actually accomplished within the past two years it has had to pay its share at a rate amounting to $15 per ft. In giving the cost of the David Neale system, the maximum rate of $5 per lin. ft. is stated and the minimum of $2 is ignored.

Regarding the $2 work recorded in the original article, and which was built at Myrick, Mo., we have, since writing that article, made a survey and examination and submit the following additional information: During the season of 1906-07 five dikes were placed, the distance from No. 1, the upper one, to No. 5, the lower one, being about 5,100 ft.; this work has now passed through two high waters. The recession of the bank in the vicinity of Dike No. 5 from April, 1905, to June, 1906, was 350 ft.; from June, 1906, to December 1907, was 100 ft., all of it taking place before the dikes were built. Since the dikes have been constructed the recession has not averaged over 25 ft. except between dikes 3 and 4, where it averages about 50 ft. It may be stated that these dikes were placed far apart, against the advice of Mr. Neale, as an experiment, the intention being to add intervening ones when it became necessary, thereby getting protection at small first cost and spreading the total cost out over several years. It is now decided to place some additional work around some of these dikes and hold the bank through another high water, at least, before building the intervening dikes.

Regarding my quotation from a statement by Mr. De Witt to the Inland Waterways Commission relative to the cost of the necessary plant for [illegible] improvement work, it was intended to show by the comparison that the plant for the David Neale system would cost much less than that needed for the standard [illegible]; and a further study of that entire statement in the light of the explanation given in the criticism does not disclose any unfairness in the comparison as made. It is true as he explains, that a part of the plant would be used a part of the time on other classes of work, and it is also true that the estimate of $17,000 given for the cost of the necessary plant for the David Neale system is considerably above the actual needs.

Since writing the original article, the Missouri Pacific Ry. Co. has purchased a plant, as follows (all second hand): a gasolene boat, $1,200, and 4 barges 29 ft. x 60 ft., for $800; making a total of $2,000. The same was worth about $3,500 when new. With this working a force of 75 men, and the rate of progress during the amount of bank protected, is as good as could be accomplished with the more expensive plant of standard mattress work.

Mr. De Witt does not mean to say that with a $27,000 plant he can do all classes of work on a 100 mile stretch of river in five years; this must be an error. Under all classes of work is included the construction of contraction works as well as of bank protection, and he would use the pile driver almost exclusively on that class of work. But such contraction works are very easily built by the use of the David Neale system, and without a pile driver. Neither do we need a grader for the Neale system, because only a very small amount of grading is necessary.

In the last sentence of the paragraph under discussion he called attention to my failure to quote his statement to the effect that the mattress could be built on a raft costing $100. As nothing was allowed in his estimate of $27,000 for mattress boats, and this $100 seemed small in the face of his so stated liberal estimate, it was not added as it really should have been. He certainly does not intend to convey the impression that continuous mattress work can be placed with a plant costing $100. If he does figure upon this basis, then he would have to provide teams or other means for bringing the brush and other materials to the top of the bank at the site of the work. Under such an arrangement, we can with the David Neale system, save the $100, because no raft or weaving barges are needed.

The David Neale system is characterized as, "A few bundles of brush and brush cribs anchored to the bank in spots, weighted down with rock, . . ." Mr. De Witt has had special opportunity to learn that we do not use a pound of rock to sink or weight down the fascines or bundles of brush and brush cribs. A very small quantity of rock (probably sufficient to cover one-tenth of the surface) is placed on top of the bank work as a precaution against a quick rise in the river. By referring to the original article you will note that the average size of the fascines is about 70 ft. long and 7 ft. in diameter, with walls and partitions 6 to 12 ins. thick; roughly figuring the cubical contents we get 100 cu. yds., fully three-fourths of which will be solid sediment or earth; about seven of these are placed as a foundation, and the mud-cell dike, or much larger part of the construction, is placed on top, the whole constituting a bank dike, having in some cases a total height of 35 ft. at the outer corner; a mass of such large size that the "mighty Missouri" cannot move it very easily from the position in which it is placed, nor can it be so injured during one season of high water but that repairs and additions can be made and tied on to it so that it will hold against another flood. But when the thin layer of mattress work begins to break up, one flood will very often clean out 1,000 or more feet of it and leave the bank entirely unprotected, so that an equal or greater amount of new work must be built to replace it.

The work being placed by the railway company is primarily for the protection of its roadbed, and that by the farmers is for the protection of their property; and the same was termed an improvement of the Missouri River under the broader interpretation of the question; it not being understood by the writer that such work must have the brand or stamp of the United States before it may be classed as improvement work. With reference to some thirty petitions for protection work, Major H. M. Chittenden, U. S. A., in annual report of Chief of Engrs., U. S. A., for 1904, p. 2301, states in substance as follows: "The difficulties of navigation are mostly due to bars and snags, these result in the main from the erosion of the banks."

The history of the improvement of the river shows that the most effective works in improving the navigable channel are those which keep the banks from caving in, but that the protection of abutting property is not recognized as a legitimate purpose of appropriations for improving rivers and harbors.

In the supplement to the Report of the Chief of Engrs., U. S. A., for 1902, p. 177, we note the following in regard to the same subject:

To illustrate this, it may be stated that in a distance of only 18 miles in the vicinity of Jefferson City, Mo., the area of new land formed by the rectification works

amounted to 5,500 acres, and the area of land protected was 12,800 acres. Computing this at a price of $50 per acre, the sum of $915,000, or over $50,000 per mile of river, was added to the wealth of the country as incidental to the improvement of navigation.

Mr. De Witt asks about the continuous revetment between the dikes at Marion, Mo. To begin with it is necessary to explain that it is dangerous to use any dike system to protect an embankment when the caving has reached up to the same, on account of the eddies that may be started thereby even before the dikes are completed. As stated in a previous paragraph, the attack reached into the embankment, necessitating a lining back of the track a few feet at one place, and the driving of an addition to a pile bridge, before active work in checking the caving could be started. As usual the attack was from a very rapidly advancing eddy (about 50 ft. in ten days). This was first checked by placing a number of large fascines. Then a dike was started some distance above the eddy with the hope of preventing further attack, but it could not be placed quickly enough to become effective in holding further caving of the small margin intervening between it and the track, and solid mattress work, although much more expensive, had to be placed.

Mr. De Witt visited this work during its progress, advising that we should have moved the track back, graded the bank down, and placed a standard mattress; predicting that we would be unable to hold our line at that point. This would have meant the expense of building considerable new embankment (10 ft. high), and placing additional sharp curvature, as well as doing the river protection work, which would be needed to hold the back line in any event, it being a case where it was much cheaper to hold the front or present line even with considerable additional expenditure for river work.

It is generally a fact that the cost is much more carefully considered by the railway company than by the U. S. Government, particularly as pertains to the entire proposition. Nor is the Government Engineer limited, as a rule, as to the exact point at which no further caving dare take place, as is the railway engineer with his fixed track.

Before the Marion work was completed the force had to be moved to Sandy Hook, Mo., where another very severe attack took place, where we had to move our tracks back about 12 ft., and throw the side track on the inside of the main line before we got sufficient mattress in place to hold the caving. We did not attempt to build dikes at this point to check the caving as it was then too close to the tracks, but placed 2,000 ft. or more of mattress, then filled out on top of the same with material dumped from cars, a sufficient distance to permit of the final replacing of the main line in its original location in a year or so and after settlement has ceased. We expect to hold this new filling with the three large David Neale dikes which were constructed on top of the mattress. At Marion we have already moved the track back to its old position, and have filled in the bridge that was driven temporarily, expecting to save a large part of the material that was used therein.

In referring to brush dikes that were built at Sandy Hook, Mr. De Witt must mean the ones that were placed by David Neale six or eight years ago and upon which not one dollar's worth of repair work was placed, and which still seem to be doing service. Owing to changes in the river above and on the other side, the attack this year took place mostly below the old work, although including the lowermost of the old dikes, which one was dropped down to the bottom of the river, and has been used as a foundation for one of the dikes just placed.

Dikes were placed at Marion also six or more years ago, and can still be found in place; the attack this year being entirely below the same.

We expect to place protection work this season at Lupus, Mo., and will have to use mattress for a certain distance because the river is right up to the track; but below the mattress, and where we will be further away from the track, we will place several dikes.

Near Wooldridge, Mo., we are using the dike system entirely because the work has been started before the river got nearer than 150 ft. to the track.

The writer would be very glad if it were a fact that he successfully induced the farmers, mentioned by Mr. De Witt, to try this system, but they took it up upon their own judgment. The railway company has since joined in with one of their associations and is aiding it because of mutual benefit derived. To another body of farmers we have furnished a survey and report.

Yours very truly,
Chas. H. Miller, Engr. River Protection.
Missouri Pacific Ry.

Little Rock, Ark., Nov. 27, 1908.

Acetylene Lights for Use in Mines.

Sir: For several years acetylene has been used in miners' lamps in France, Germany and Belgium to a large and steadily increasing extent, until at present it is used almost exclusively in over 200 mines and by approximately 50,000 men. The use of acetylene saves nearly 50% of the cost of lighting a mine, while giving more and better light. Nevertheless the introduction of acetylene into mines, up to the last two years, has been very slow in this country. Its use is now, however, coming to be recognized as an important advance, and it promises shortly to replace all other means of illumination, except in special cases.

Candles, which are largely used throughout our western mines, remove seven times as much oxygen from the air and kerosene five times as much oxygen as acetylene. The products of combustion given off by candles are ten times and from kerosene nine times as great in volume as are given off by acetylene. While acetylene mine lamps give no smoke whatever, every miner is familiar with the difficulty from the smoke given off by other illuminants. The actual amount of illumination given by candles and kerosene is lessened by a very large percentage by the smoke and mist which rapidly accumulate.

It has been found, in actual experience, that in entries which are 60 to 70 ft. ahead of the air, there is not the slightest particle of smoke from an acetylene lamp and the entry is just as clear at the end of the shaft as it is at the beginning.

The acetylene flame is not easily blown out, the motion of the miner does not cause it to flicker badly, and it burns brilliantly in an atmosphere so foul that candles flare and go out. In fact, acetylene will not deprive the miner of light until the atmosphere is so bad that it will not support life.

For underground surveying and mine inspection, the use of acetylene is of great importance. Maps and records escape the usual accompaniment of grease and smudge. The acetylene flame is so small and clear that it affords an accurate point on which to sight instruments.

Another use for acetylene in somewhat larger units is found where the rays are concentrated by a reflector, in which case a brilliant illumination can be thrown into inaccessible places where distant bays, high backs, caved places and other difficult and otherwise hidden parts of the mine can be explored with convenience, and in case of emergency, without danger.

In actual practice, it has been found that 4 oz. of calcium carbide at 4 cts. per lb. will give nearly ten candle power clear illumination without smoke for five hours. Candles in many parts of the country, counting four candles to the ten-hour day, would cost 5 cts. per day. There seems, therefore, to be no reason why acetylene should not be introduced provided a proper lamp at an economical price can be devised. As a matter of fact, practical experience has demonstrated that some of the miners' lamps now upon the market meet all the necessary requirements both as to economy, lasting quality and practicability in use.

Acetylene miners' lamps are now frequently found in mines throughout the country, Pennsylvania, New Jersey and Illinois leading, though many other states are using the new light. The greatest number used by any one concern in its mines is probably by the New Jersey Zinc Co., which has adopted acetylene illumination for all its mines. The number of miners' lamps in use in the mines of this company is about 3,000, and it has been found, in practical use, that the saving is at least 2 cts. per day for every miner.

The subject of better illumination in mines is worthy the attention of every mine owner and engineer. It is equally worthy of the attention of every mining organization, as well as every individual miner, because a change to better illumination at half the cost, with greater output, safety, comfort, and above all, good health, are matters of such vital importance that no careful manager will fail to investigate the subject.

Yours very truly, A. C. Morrison.
Secy. International Acetylene Association.

157 Michigan Ave., Chicago, Ill., Dec. 3, 1908.

SILT IN THE PROPOSED RESERVOIRS OF THE OHIO BASIN.

By HERMAN STABLER.*

An interesting side light upon the system of reservoirs proposed by Mr. M. O. Leighton† for flood prevention, navigation improvement, and water power in Ohio River basin is furnished by a consideration of the question of silting up of reservoirs with consequent loss of effective capacity. This matter has been touched upon by engineers in published discussions of the proposed system as being a possible cause for its rejection. Modern practice in storage reservoir construction has dealt with the silt problem effectively. Inasmuch as streams bearing 50 to 100 times as much suspended matter as the tributaries of the Ohio have been utilized effectively for storage purposes in the Far West, silt accumulation under the worst conditions in the Ohio valley should be viewed as a factor to be eliminated by design rather than as a cause for abandoning the reservoir system without investigation.

How far the plans of such a system should be modified on account of river sediment is one of the many questions involved in the comprehensive investigation Mr. Leighton has recommended. Fortunately, data upon this subject, sufficient to warrant an estimate of probable silt accumulations, has already been accumulated. The stream gaging work of the Water Resources Branch of the United States Geological Survey and the recent series of analyses of stream waters made by the same branch under the direction of Mr. R. B. Dole form the chief basis of the accompanying tabulated estimate. The writer desires to express his thanks to Mr. Leighton for the use of storage data and determinations of suspended matter, not all of which have been published previously.

Column 4 in Table I. is the continued product of column 2, column 3 and the factor 0.985. Where no analyses are available the figures in column 4 are estimated from known data on adjacent streams. In the case of the small tributaries, the highest value for the large tributaries was arbitrarily selected. Column 4 multiplied by .02105 gives column 5, the volume of sediment in thousands of cubic feet upon the assumption that 95 lbs. of dried suspended solids will produce a cubic foot of sediment. With reservoirs of the size proposed it is fair to assume that all suspended matter will be deposited as a sediment accumulation unless special means be provided for its removal. The product of columns 5 and 6 divided by 1,000 will therefore give column 7, the annual sediment accumulation in millions of cubic feet. Finally, comparison of columns 7 and 8 gives column 9. It is this last column that is of greatest interest and presents a set of figures that will doubtless surprise those who have not given the matter careful study. Although an effort has been made

*Assistant Engineer, Water Resources Branch, United States Geological Survey.
†Engineering News, May 7, 1908.

TABLE I.—ESTIMATED RATE OF SEDIMENT ACCUMULATION IN RESERVOIRS IN VARIOUS PARTS OF THE OHIO DRAINAGE BASIN.

Stream.	Average annual run-off (sec. ft. per sq. mile.)	Suspended matter, parts per million.	Annual sediment per square mile. Short tons.	Annual sediment per square mile. 1,000 cubic ft.	Area above reservoirs. (sq. miles.)	Annual sediment accumulation. (1,000,000 cu. ft.)	Capacity of reservoirs. (1,000,000 cu. ft.)	Years required to reduce capacity of reservoirs 10%.
Tennessee River	....	...	...	5.05	23,030	116.2	861,420	740
Knoxville, Tenn.	1.56	156	240	5.05	.....	.....	.....	...
Gilbertsville, Ky.	1.60	127	200	4.21	.....	.....	.....	...
Cumberland River	....	...	...	4.78	4,090	19.6	130,040	670
Kuttawa, Ky.	1.40	165	227	4.78	.....	.....	.....	...
Kentucky River	....	...	...	4.09	2,340	11.0	101,100	920
Frankfort, Ky.	1.60	142	223	4.69	.....	.....	.....	...
Licking River	....	...	220	4.63	600	2.8	23,300	830
Big Sandy and Little Kanawha Rivers*	....	...	200	4.21	4,540	19.1	226,872	1,190
Kanawha River	....	...	180	3.79	12,540	47.5	321,330	680
Monongahela River	....	...	203	4.27	3,222	13.8	173,340	1,260
Elizabeth, Pa.	1.80	84	149	....	.....	.....	.....	...
McKeesport, Pa. (Youghiogheny River)	2.30	163	369	....	.....	.....	.....	...
Allegheny River	....	...	77	1.62	2,714	4.4	106,092	2,410
Kittanning, Pa.	1.62	30	48	....	.....	.....	.....	...
Brilliant, Pa.†	1.62	48	77	....	.....	.....	.....	...
Scioto River	....	...	68	1.43	1,267	1.8	8,990	500
Small tributaries	....	...	240	5.05	4,119	20.8	193,265	930
Total	....	...	...	....	58,462	257.0	2,145,740	835

*This estimate agrees closely with the sediment accumulations at Catlettsburg, Ky., reported by Patton in Engineering News of October 4, 1906.
†Report of Pittsburg Filtration Commission. Analyses under direction of Allen Hazen. The estimate agrees well (within 10 per cent.) with sediment accumulations for a term of years in Pittsburg water supply reservoirs as given by Marsh, "Engineering Record," Sept. 3, 1904.

to present the worst probable conditions of known data, it appears in the result that from 500 to 2,410, with an average of 835 years are required for a 10% reduction in capacity of the proposed reservoirs.

The variability in the figures illustrates a point to be considered in the selection of reservoir sites. The Tennessee River carries the most sediment, but the reservoirs proposed for its basin do not lose capacity as rapidly as those in several other river basins. The Scioto River carries the smallest load of suspended matter, but the reservoirs accredited to its drainage area are nevertheless the most quickly filled with silt. The Allegheny reservoirs receive one-eighth more sediment per square mile than those for the Scioto, but accumulate sediment only one-fifth as rapidly, filling more slowly than any. Were the estimate extended to individual reservoirs, these seeming eccentricities would doubtless be even more apparent. The controlling factor is clearly shown to be the relation of reservoir capacity to tributary drainage area. A storage reservoir capable of retaining the entire annual flow of its tributary streams will obviously fill only half as fast as one upon the same site with capacity merely sufficient to store 50% of the annual flow.

A practical example of rapid silting is furnished by a diversion dam and reservoir upon the Tuolumne River at La Grange, Cal., where recent measurements of silt deposits show the reservoir to have lost more than 50% of its capacity in ten years. The silt stored represents .0067% of the volume of the stream. Analyses of water samples collected below the dam show that .0043% additional silt is carried past the dam site, making the total silt load 0.011% of the volume of the stream. The capacity of the reservoir was but 0.125% of the annual stream flow. In the following Table is shown the time in years required to reduce by 10% the capacity at La Grange of reservoirs of various assumed capacities with the partial and total silt load factors given above.

Capacity of reservoir. (Per cent. of annual stream flow.)	Years required to reduce capacity of reservoir 10%. Silt = .0067% stream volume.	Silt = .011% stream volume.
0.125	1.86	1.14
1.0	14.8	9.1
25.	371.	227.
50.	742.	455.
75.	1,113.	682.
100.	1,484.	909.

The relation of silt load and relative reservoir capacity are both clearly indicated by this table. The Tuolumne River carries no more silt than several streams of the Ohio valley. The La Grange reservoir has lost its capacity not because it is located upon a heavy silt-bearing stream but because the silt from a comparatively large stream is deposited in a small storage basin.

To illustrate this point further and to show that the results given for Ohio River reservoirs are by no means unusual, the suspended matter determined from analyses covering a period of approximately one year or more compiled from various sources, silt load (estimated upon assumption that 95 lbs. of silt will produce a cubic foot of sediment), and time in years required to fill reservoirs of various assumed capacities are given in Table II. for 177 streams of the United States.

Streams of classes 1, 2 and 3 include, respectively, 4, 6 and 7 tributaries of Ohio River. All streams east of the Mississippi River, including the turbid rivers of the Southern States, belong to the first four classes. Classes 7 and 8 include only streams of the arid West. In class 8 are found the Gila River at Florence, Ariz., a storage site rejected by the Reclamation Service because of the excessive silt load, and the Rio Grande at El Paso, Tex., where, in flood, the stream moves enormous quantities of sand and silt. The table shows clearly the desirability, in selecting storage sites in the Ohio basin, of choosing those points where reservoirs capable of storing at least 50% of the annual stream flow can be economically constructed. Obviously, however, such sites would be selected from a consideration of the requirements of river regulation.

Although the sediment observations are insufficient to warrant detailed estimates for silt accumulation in the individual reservoirs proposed by Mr. Leighton, if these storage basins be examined with reference to the data of the foregoing table, it will be seen that very few may be expected to lose 10% of their capacity in less than 500 years; yet these sites were tentatively chosen for river regulation without a detailed consideration of the silt problems involved. Hence the importance of the silt question, even in influencing a choice of reservoir sites, does not appear to be very great.

The reservoir system, if built, should be designed and constructed with a view to its value to posterity, but it can scarcely be expected that the present generation will undertake any great outlay entirely for the benefit of those who may inhabit the Ohio valley several hundred years hence. As the silt accumulations increase, the engineers of the future will have to decide whether the annual addition of 9,450,000 cu. yds. (for the reservoirs here listed) can be removed to best advantage by sluicing, dredging or otherwise. The engineer of the present will have done his full share by providing sluice gates and selecting storage sites of high relative capacity, matters necessary for river regulation if the stored water were clear as crystal.

ACCURACY OF ESTIMATES.

For the benefit of those who may question the estimates in Table I., the following discussion of their probable accuracy is appended: The value of the estimates presented depends upon the accuracy of the stream flow data, the relation assumed between weight of suspended matter and volume of sediment accumulation, the accuracy of values used for suspended matter, and the method of calculation. The flow data is the average of stream measurements for a term of years and probably is within 10% of the true value.

The relation assumed between weight of suspended matter and volume of sediment accumulation (95 lbs. of suspended matter per cubic foot of sediment) is one that appears to be on the side of conservatism. Extremes are represented by the determinations of Humphreys and Abbott* upon sediments at the mouth of Mississippi River, 165 to 175 lbs. per cu. ft., and by those of Follett and Hall,† who found that a cubic foot of Rio Grande sediment contained but 53 lbs. of solid matter. For an average of Mississippi River sediment, Humphreys and Abbott assumed a specific gravity of 1.9, corresponding to 119 lbs. per cu. ft. These three values would indicate, respectively, 1,500 years, 1,050 years, or 470 years instead of 835 years as the average period before a 10% reduction in capacity will occur. The following weights per cubic foot for various substances are taken from the Physical Tables of the Smithsonian Institution: Gravel, 94 to 112; dry sand, 87 to 103; marl, 100 to 156; clay, 122 to 162; dry earth, 100 to 120; mud, 102. The addition of moisture to dry materials of this character will swell the volume and therefore smaller weights than those shown will be required to produce a cubic foot of moist material. [illegible] the Ohio basin the suspended matter is largely argillaceous and will form compact sediments. The estimates indicate that a long period of time will ensue before sediment removal will become a necessity. With increase of [illegible] greater compactness is to be expected: much of the sediment will be subject to great pressure from supernatant water in the reservoir, another condition tending toward a high degree of compactness. It is believed, therefore, that there is much greater probability of the sediments assuming less rather than greater volumes than those used in the estimates.

A chance for error appears to lie in the values taken for suspended matter. These are based upon actual determinations of suspended matter from samples of river water collected daily for a period of approximately one year. How far this average for a single year may vary from the average for a term of years is a matter of conjecture, for determinations of suspended matter upon Ohio River tributaries for a term of years are not available. Such a set of yearly averages for the Mississippi are given in the Report of the Chief Engineers, U. S. A., 1894, p. 1345. Of fifteen years' results only three vary more than 25% from the mean. The average deviation is but 20% of the mean and the probable error of the average for a single year is less than 17% of the mean. Inasmuch as Ohio River tributaries are not subject to such great range in content of suspended matter as the Mississippi, there is no reason to expect a greater error than the foregoing in basing estimates upon a single year's determinations, though in streams of the arid and semi-arid regions a series of years would be required for an equally reliable estimate. In streams such as those to which the estimates of this article relate, suspended matter will usually vary directly with discharge. The determinations of suspended matter which have been used were made in years for which the discharge was somewhat in excess of the average. This would indicate that the values for suspended matter are also somewhat in excess of the average. It can be stated, therefore, with a considerable degree of confidence, that the values used are not too small.

Another factor to be considered is the possibility of an amount of saltatory matter sufficient to effect appreciably the estimates. So far as the writer is aware, no reliable determinations of the quantity of such material are available. Humphreys and Abbott estimated the material pushed into the Gulf of Mexico along the bottom of the Mississippi as about 11% of the suspended matter, but this can be considered as little more than a guess. Undoubtedly, the silt deposits of each stream would receive an increment from matter rolled along the river bottom. That such material is usually small in amount as compared with the load of suspended matter is a commonly accepted belief. In the opinion of the writer it will not greatly affect the value of his estimates.

Finally, the greatest chance for error, but one for which no correction can be applied, is to be found in the attempt to estimate average silt accumulation from the product of average stream flow and average suspended matter. The sum of the products of the corresponding terms of two ascending series is greater than the products of the sums of the series. It is probable that some reasonably simple law governing approximately the relation of suspended matter to stream flow could be deduced for small streams. With increased drainage area (particularly if the tributaries be large, the character of soil and cultural features diverse, and the width of the stream basin comparatively great), the law becomes hopelessly complex and we may find the greatest amount of suspended matter coincident with a medium or low stage of flow. Nevertheless, there will always be found a tendency toward increase of suspended matter with increase of flow if a sufficient number of observations be taken. This tendency produces an ultimate effect similar to that noted for the case of two ascending series and the product of

*The Physics and Hydraulics of the Mississippi River, p. 143.
†Third Ann. Report, U. S. Reclamation Service, p. 401.

TABLE II.—REDUCTION OF RESERVOIR CAPACITY BY SILT UNDER VARIOUS CONDITIONS.

Class.	Number of streams.	Suspended matter in parts per million.	Max. silt load for class. (Per cent. of stream flow.)	Original capacity of reservoir. (Per cent. of annual flow.) 25	50	75	100
				Years required to reduce capacity 10 per cent.			
1	47	0 to 50	.0033	760	1,520	2,270	3,030
2	39	51 to 100	.0066	380	760	1,140	1,520
3	36	101 to 200	.0132	190	380	570	760
4	9	201 to 300	.0197	130	250	380	510
5	5	301 to 500	.0329	76	150	230	300
6	15	501 to 1,000	.0658	38	76	110	150
7	24	1,001 to 10,000	.6580	4	8	11	15
8	2	14,100	.9300	3	5	8	11

average flow and average suspended matter will be less than the true silt load, which can only be found by adding the products of flow and suspended matter for each infinitesimal of time.

In order to obtain some idea of the error thus introduced the silt load was estimated on two streams of the Ohio valley by taking the product of average discharge and average suspended matter for a year and the sum of the products of ten-day averages of discharge and suspended matter for the same period. One of these streams, the Allegheny at Kittanning, has a narrow basin, is fed by small tributaries, and drains an area of comparatively uniform conditions of geology and culture. The quality of the water varies with the stage of flow in an almost ideal manner. So close and simple is the relation, indeed, that the dissolved mineral constituents can be expressed as a simple function of the gage height. The relation of suspended matter to gage height is more complex, but a marked tendency for increase of suspended matter with a power of the gage height between the first and second is evident for most stages. In addition, wide range of flow and low suspended matter combine to make this a good example for the Ohio valley of a stream subject to great extremes of silt load, whose floods will carry a large proportion of the year's total sediment. The comparison above noted indicates that the product of average discharge by average suspended matter should be increased by 50% to give the true silt load, and that the largest flood of 1907 carried nearly a third of the annual total. If results were available for years of greater flood, a greater variation would be expected. Comparison of turbidities at Pittsburg for the flood of 1907 and that of 1905, however, indicates that the increase in discharge for the very high stages is accompanied by a much smaller increase in suspended matter. A year of several floods of medium height would therefore be accompanied by a greater total silt load than one of a single great flood.

The second river examined was the Tennessee at Knoxville. This river is formed by the junction of two large streams a short distance above the city. That these streams are subject to widely diverse conditions is evidenced by the fact that the dissolved mineral constituents at Knoxville appear to bear little relation to the river stage. A relation between stream flow and suspended matter is even less apparent. The year for which results are available (1906-7) includes one of the great floods of the Tennessee. The silt carried past Knoxville, however, was less during this flood than during a smaller flood at another time of the year. Possibly the great flood was caused chiefly by a comparatively clear water stream and the lesser by a turbid tributary. In this case the great flood carried less than a tenth and the smaller flood less than a sixth of the year's silt load. This condition was found, although the Tennessee is a stream of rapid floods and flashy discharge. The comparison made indicates that 108% of the product of average discharge and average suspended matter is the true basis for estimating silt load. In connection with a consideration of the percentage value of a correction such as this it should be noted that the per cent. correction will usually be greatest for streams of nearly equal run-off when the weight of suspended matter is least, and therefore when the rapidity of silt accumulation is least. The importance of the correction, viewed practically, is therefore less than might appear at first glance.

From a consideration of the results of these streams and the probable relations that other tributaries of the Ohio bear to them, it seems likely that a mean additive correction of perhaps 10 to 15% should be applied on account of using average values for suspended matter and runoff. The available data is insufficient to warrant detailed estimates, and the whole matter is so largely speculative that no such correction was applied.

Summarizing the probable accuracy of the estimates, the assumed relation between weight of suspended matter and volume of sediment and the values accepted for suspended matter are such as to magnify the rapidity of silt accumulation. On the other hand, the use of averages for computation and the neglect of saltatory material have the opposite tendency. It is the opinion of the writer that these sources of error will about neutralize each other so that the tabulated average of 835 years is not in error by more than 10 to 15% at most. Estimates for individual streams are more questionable but are believed to be well within 50% of the true value in every case. This view is corroborated by the close agreement between the estimates and actual measurements of silt in reservoirs at Pittsburg and Catlettsburg, as cited above.

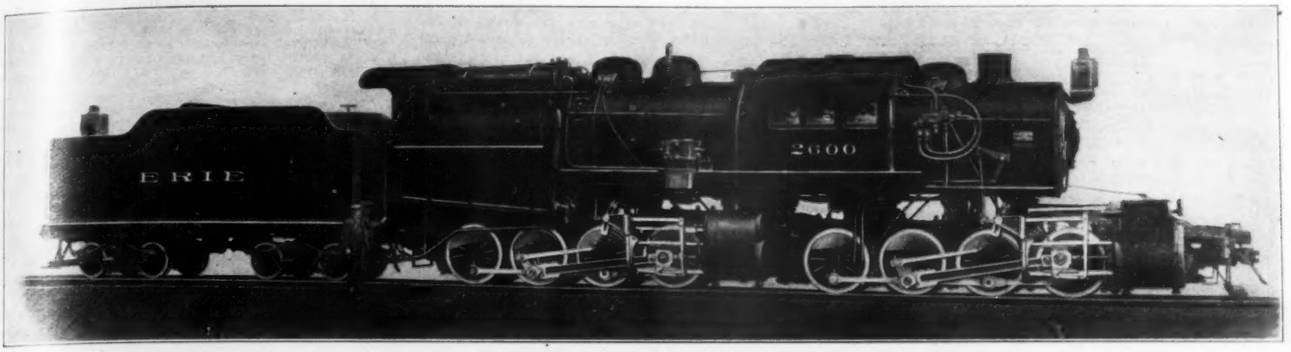


FIG. 1. MALLET ARTICULATED COMPOUND FOR FREIGHT SERVICE, ERIE R. R.
(The heaviest and most powerful locomotive in the world. Built by the American Locomotive Co.)

ARTICULATED COMPOUND LOCOMOTIVES.*

By C. J. MELLIN,† M. Am. Soc. M. E.

The constantly increasing demand for heavier power, made by most railways in the country during the last decade, and especially by those roads having heavy gradients combined with sharp curves, brought out various designs which on account of rail pressure limitations required so many coupled wheels that the length of the rigid wheel base made them unwieldly to operate with efficiency. This demand for greater power was, of course, greatest in mountain districts where heavy grades and sharp curvatures generally go together, necessitating, for safe operation, comparatively short wheel bases, reduction in engine resistance and wear of wheel flanges and rail, together with moderate weight of the working parts of the engine.

In striving to meet this demand, locomotive designers and builders were brought face to face with an unsurmountable barrier to further progress in the enlargement of engines on the old lines; and in 1902 the American Locomotive Company decided to work out a design of a heavy, powerful locomotive for the Baltimore & Ohio R. R., having two sets of engines under one boiler capable of adjusting themselves independently to the alinement of roads with curvatures up to 30°, on the principle developed by the prominent French engineer Anatole Mallet of Paris. Mr. Loree, then President of the Baltimore & Ohio R. R., considered the question seriously; but it was first thought that it would be no advantage to the Baltimore & Ohio R. R., even if it proved successful, and the subject was left undecided for some time. In the latter part of 1903, on the recommendation of Mr. J. E. Muhlfeld, who in the meantime had become General Superintendent of Motive Power, the Baltimore & Ohio ordered one engine of this type, which was built at the Schenectady Works of the American Locomotive Company during the winter of 1903 and 1904, to suit the conditions of that railway.

Propositions for building the Mallet type of engine had been made both by Mr. S. M. Vauclain, General Manager of the Baldwin Locomotive Works, and by the writer, several years prior to the above date, but the one under consideration is, so far as the writer is aware, the first engine of this type completely designed and constructed in the United States. The original Mallet type of engines built in Europe date back to the early '90's, but its history would be too extended to embody in this paper.

GENERAL ADVANTAGES.—This Baltimore & Ohio locomotive, which was of unusual dimensions for that time, was exhibited at the Louisiana Purchase Exposition at St. Louis in 1904. A great number of locomotives of this type, of various sizes, have since been built for other roads as forerunners of what promises to be the most powerful and efficient type of the freight engine of the future. The form permits of the application of cylinders of largest dimensions, as well as of the largest boiler capacity, by the distribution of the weight over a long wheel base and over many driving axles. Up to the present date a tractive power of about 125,000 lbs. has been reached, whereas the ordinary types of engines rarely exceed 44,000 lbs. (See Table I for comparison between a heavy Mallet and the heaviest engines of ordinary types.)

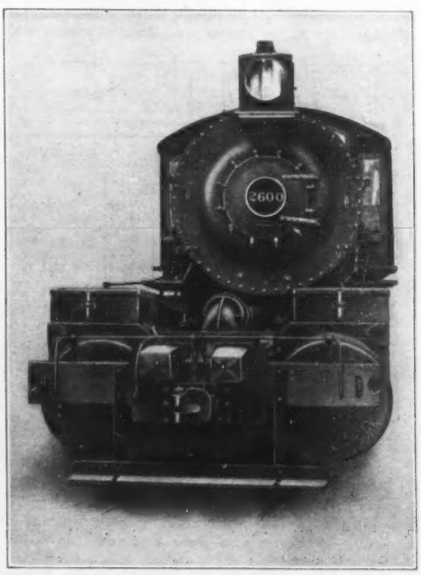


Fig. 2. Front View of Articulated Locomotive Rounding a Curve.

The Mallet articulated arrangement presents the advantages of enormous tractive power concentrated in the combination of the two sets of engines with practically no increase in the individual weights of the moving and wearing parts over those of engines of the ordinary types; double expansion of the steam; simplicity and ease in operation; and a short rigid wheel base, with the weight distributed over a long total wheel base, resulting in the greatest flexibility and ease in

*Condensed from a paper presented before the American Society of Mechanical Engineers, December, 1908.

†American Locomotive Co., Schenectady, N. Y.

track and bridges. It was also found possible at the very first to provide an engine under the control and operation of a single crew, having double the power of the largest engines of the ordinary type. These advantages are most clearly evidenced by the comparisons in Table I. The comparison in Table II, however, between one of the lighter designs of Mallet engines and a few engines of the ordinary types, having approximately the same power, clearly shows that the same tractive power

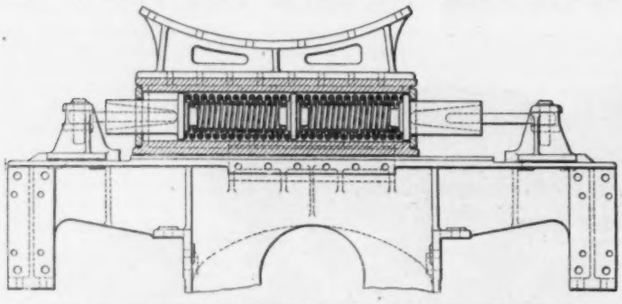


FIG. 3. CENTERING SPRINGS OF FORWARD ENGINE OF ARTICULATED LOCOMOTIVE.

is obtained with weights of moving and wearing parts equivalent to those of an ordinary engine of half the tractive power.

THE ARTICULATED CONSTRUCTION.—In general, the Mallet articulated locomotive consists of a front system with its frame work, low-pressure cylinders with their attachment of guides and rods, one set of driving wheels, cross-ties and boiler supports; and a rear system with the high pressure cylinders and frame work, fixed to the boiler as though an ordinary engine were placed under the rear part of the boiler.

The support of the rear system on the front engine must be capable of sliding laterally to allow the front engine to enter a curve and form an angle with the rear engine. For this reason the two engines are hinged together by vertical swivel pins located, preferably, slightly ahead of a point midway between the two wheel sets, because the swivel point being so located aids the guiding of the rear engine into curves. A lateral spring applied in the front part of the leading engine permits an elastic yielding of that engine into a curve and restores alinement in leaving it (Fig. 3.)

It is not practical to place the sliding support on the theoretical location because the front engine would then be unstable and tip one way or the other, like a scale beam, with the slightest disturbance due to change of weight on grades, but it should be on a convenient location in front of the virtual one. This, of course, would

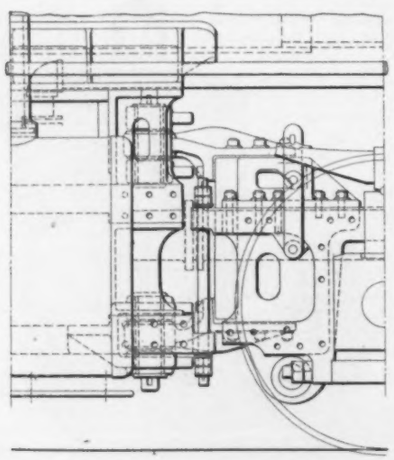


Fig. 4. Hanger Bolts Connecting Side Frames of Forward and Rear Engines.

allow the front engine to tip forward as the imposed weight on that point would be less and the arm from the driving wheel base center, shorter. To correct this disturbance, vertical hanger bolts are applied between the upper member of the frame at the extreme rear end of the front engine and the lower member at the extreme front end of the rear frame (Fig. 4). With these bolts or hangers, the proper alinement of the front engine may be adjusted at will and the effect of the combined supports is restored to the virtual supporting point. This method reduces the pressure on the sliding plate and imposes load on the bolts in proportion to the respective distances of the two supports from the virtual supporting center.

It is evident that the supporting bearing must be self adjusting to bear evenly at all alinements of the engine. To accomplish this, the lower, or what we may call the pillow plate, has a ground surface on its upper side on which a corresponding upper plate can slide with the movement of the boiler; while its under side is slightly curved to allow a longitudinal rocking. This pillow plate is held in position by means of two dowel pins of about 2 ins. in diameter recessed about ¾-in. into the plate and an equal amount doweled into the cross-tie on which it rests approximately in the middle of the convex or curved part. In this way the pillow plate is kept in position without destroying its ability to adjust itself so as to present a uniform bearing for the upper or sliding plate at any alinement of the engine.

Opinions on the use of a truck in the articulated engine are divided, but because of the many objections connected with the application of a front truck in freight service as to the first cost, maintenance, dead weight and unfavorable distribution of the machinery sometimes causing serious obstructions, nothing is gained by this objectionable feature, as it is practically the same as putting a truck ahead of a truck. The front engine in going ahead being a truck in itself, the first pair of drivers has a leverage in its favor in entering the curve. The reason for this is that the virtual support of the weight of the rear system, which is carried by the front, falls back on the latter and in the rear of the sliding bearing; thus allowing a great part of the load of the rear engine to be carried by the hanger bolts between the two frames, Fig. 4. This alone reduces the pressure very materially on the sliding plate which, together with the short arm for friction resistance and long guiding arm for the flanges, reduces the pressure on them to a small fraction of the total friction load on the sliding plate; and comparatively light centering springs will therefore suffice for this purpose and still further reduce the flange pressure.

These same leverages and resistances act equally favorable in backing, as it is simply a reversed operation and the rear drivers have to swing the boiler against these resistances. Therefore, it is important that these should be small and with the shortest possible leverages, which naturally also minimizes the flange pressure on the rear wheel, that is, the last wheel of the engine, which then has to do the guiding.

With the use of a front truck, the center of support is shifted forward, and with it the virtual and actual supporting points of the weight of the rear engine carried on the front system. The weight on this support must, therefore, be increased by the amount of the carrying capacity of the truck, with little or no opportunity for transferring any of this load through the hanger bolts, practically doubling both the load on the sliding plate and the length of the resistance arm. At the same time, by the application of a front truck, the guiding point is moved forward so that the leverage has been increased to offset the increased side resistance of the engine. The guiding power of the truck, however, is limited to its swing resistance. This, therefore, may leave as much or more guiding to be done by the front drivers as where no truck is used, because of the increased moments of resistance of the engine in curving. A more serious matter, however, is the backing with a front truck. The high resistance moments in the front must be overcome by the rear drivers, which are doing the guiding, and it is easy to understand how fast the flange pressure is multiplied by this displacement of the load and the safety margin for derailing dangerously reduced. It is therefore evident that a truck is a necessity when a front truck is used, [illegible] backing is to be considered, thus curing one evil [illegible] another.

Even with the application of a rear [illegible] the objections caused by the application of the [illegible] truck will be only partly compensated for, as the [illegible] swing very essential objections still remain:

(a) The application of a front truck increases the distance of the front buffers from the first [illegible] of drivers by 15 to 20%, and consequently throws the front drawhead of the engine further out from the [illegible] of the track on curves than where no front truck is used.

(b) It increases the total wheelbase of the [illegible] line about 8 ft. 6 ins., requiring an 80-ft. turntable to take an average sized engine with its tender.

(c) Additional dead weight to be carried [illegible] the truck must be provided and the expenses in maintenance and first cost by the use of it are items that should not be overlooked.

(d) The long arms for friction resistance [illegible] the sliding plate with increased load on them, due [illegible] the front truck, will not be lessened by the application of a rear truck.

(e) When only a front truck is applied, the boiler is necessarily moved so far forward that it leaves scant room for the valve motion on the rear engine. The result of this is that the width of the firebox is necessarily limited to about 72 ins.

In the case of passenger engines, however, large wheels would be used, and only four pairs of drivers can or need be applied. A four-wheel front truck with rigid center-pin, and rigid trailing wheels, works in conveniently in the place of a third pair of drivers in each engine, front and rear respectively, which otherwise with their large diameter make the engine unduly long.

Continuing with the construction of an engine without a truck, the spring rigging and equalization are next to be taken into consideration. The springs are most conveniently located above the boxes and frame, except under the firebox where they must be placed between the adjacent wheels with yokes over the boxes in the usual manner. On the front engine, all springs on each side are equalized together with a cross equalizer between the front springs. The rear engine is equalized in the same manner, except that the cross equalizer is omitted. This makes a three-point suspension of the whole engine and prevents any excessive local stresses of a diagonal nature on an uneven road, as the front engine accommodates itself very freely to the rear engine. The wheels then follow the rail comparatively freely and easily on the twisting parts; at the rising of the outer rail, on entering and leaving curves, as well as on any other unevenness of the road.

THE COMPOUND FEATURE.—The high-pressure cylinders, as previously stated, are located under the cylindrical part of the boiler, generally slightly in the rear of the middle of the barrel. They are provided with a cast-steel saddle, bolted or riveted to the shell of the boiler by its upper flange and to the cylinder half saddle by its lower flange. The cylinder saddles, however, are not divided in the center of the engine, but sufficiently to one side to allow the receiver pipe with its

TABLE I.—COMPARISON OF PRINCIPAL DIMENSIONS AND WEIGHTS OF INDIVIDUAL PARTS OF HEAVIEST MALLET ENGINE AND HEAVIEST DESIGNS OF ORDINARY TYPES.

Road	Erie	D. & H.	P.B. & L.E.	A. T. & S. F.	A. T. & S. F.	B. R. & P.
Builder	A. L. Co.	A. L. Co.	A. L. Co.	A. L. Co.	Baldwin	A. L. Co.
Type	Articulated 0880	Consol. 280	Consol. 280	Decapod 2100	Decapod 2100	Decapod 2100
Simple or compound cylinders	Comp. 4 cyl. articulated	Simple	Simple	Comp. 4cyl. tandem	Comp. 4cyl. tandem	Simple
Diameter and stroke	25 & 39 by 28 in.	23 by 30 in.	24 by 32 in.	17½ & 30 by 34 in.	19 & 32 by 32 in.	24 by 28 in.
Boiler pressure	215 lb.	210 lb.	210 lb.	225 lb.	210 lb.	210 lb.
Diameter of driving wheels	51 in.	57 in.	54 in.	57 in.	57 in.	52 in.
Tractive power	94 800 lb.	49 090 lb.	60 900 lb.	55 300 lb.	62 500 lb.*	55 350 lb.
T. P. working simple	120 000 lb.			63 000 lb.	64 100 lb.	
Total weight	410 000 lb.	246 500 lb.	250 500 lb.	259 800 lb.	266 500 lb.	268 000 lb.
Weight on drivers	410 000 lb.	217 500 lb.	225 500 lb.	232 000 lb.	237 000 lb.	243 000 lb.
Factor of adhesion	4.33	4.38	3.7	4.20	3.82	4.39
Rigid wheel base	14 ft. 3 in.	17 ft.	15 ft. 7 in.	20 ft.	20 ft. 4 in.	19 ft.
Average load per wheel on rail	25 625 lb.	27 200 lb.	28 200 lb.	23 200 lb.	23 700 lb.	24 300 lb.
Weight of main rod	968 lb.	985 lb.	1144 lb.	817 lb.	1028 lb.	1050 lb.
Weight of inter. rod	406 lb.	681 lb.	424 lb.	574 lb.	x	449 lb.
Weight of front rod	133 lb.	188 lb.	260 lb.	158 lb.	x	187 lb.
Weight of back rod	135 lb.	208 lb.	200 lb.	158 lb.	x	190 lb.
Weight of back inter. rod				244 lb.	x	190 lb.
Weight of h.p. piston and rod	790 lb.	782 lb.	693 lb.	1130 lb	1075 lb	830 lb.
Weight of l.p. piston and rod	993 lb.					

* Calculated by the formula used by the Baldwin Locomotive Works for figuring the tractive power of 4-cylinder tandem compound locomotives.

TABLE II.—COMPARISON OF PRINCIPAL DIMENSIONS AND WEIGHTS OF INDIVIDUAL PARTS OF MALLET ENGINE AND DESIGNS OF ORDINARY TYPES OF FREIGHT ENGINES HAVING APPROXIMATELY SIMILAR TRACTIVE POWER.

Road	Central Railway of Brazil	N. Y. C. Lines	Erie
Builder	A. L. Co.	A. L. Co.	A. L. Co.
Type	Articulated 0660	Consolidation 280	Consolidation 280
Simple or compound	Compound 4 cyl. articulated	Simple	Simple
Cylinders diameter and stroke	17½ in. 28 by 26 in.	23 by 32 in.	22 by 32 in.
Boiler pressure	200 lb.	200 lb.	200 lb.
Diameter of driving wheels	50 in.	63 in.	62 in.
Tractive power	42 420 lb.	45 700 lb.	42 500 lb.
Tractive power working simple	52 000 lb.		
Weight on drivers	206 000 lb.	208 000 lb.	179 000 lb.
Total weight	206 000 lb.	234 000 lb.	202 000 lb.
Factor of adhesion	4.85	4.5	4.2
Rigid wheel base	9 ft.	17 ft. 6 in.	17 ft.
Average load per wheel on rail	17 166 lb.	26 000 lb.	22 375 lb.
Weight of main rod	417 lb.	821 lb.	848 lb.
Weight of intermediate rod		403 lb.	509 lb.
Weight of front rod	208 lb.	185 lb.	246 lb.
Weight of back rod	92 lb.	201 lb.	210 lb.
Weight of h.p. piston and rod	297 lb.	664 lb.	516 lb.
Weight of l.p. piston and rod	459 lb.		

ball joint to be placed in the center line of the engine (Fig. 5).

The low-pressure cylinders, Fig. 5, are fixed to the front engine with so-called "half-saddles," but are not connected to the boiler except by the flexible exhaust pipe. With the large low-pressure cylinders required for the desired power, there will naturally be considerable suction of cold air through the cylinders in running with the steam shut off, which is very objectionable for several reasons, one of which is the sudden cooling of the cylinder walls and passages. To obviate this, by-pass valves are located in the cylinder castings. These automatically open communication between both ends of the cylinder when the throttle is closed, so that a certain amount of air can circulate through this passage to and fro with the movement of the piston, and thereby prevent the sudden changes in the temperature and relieve the pumping of air through the exhaust nozzle, and also minimize unnecessary agitation of the fire.

The steam enters the high-pressure cylinders directly from the dome, where the throttle is located, as usual, and it exhausts into the high-pressure cylinder saddles on each side and meets at a point where the steam enters the intercepting valve. After passing through into the receiver pipe placed in the center of the front engine at a convenient height above the axles, it branches off through a "Y" pipe to each of the low-pressure cylinder saddles and through passages in these saddles to the steam chest. The exhaust from the low-pressure cylinders returns through the saddles and meets in a pipe delivering to the common exhaust pipe and the stack.

In order to obtain high efficiency and emergency power, various special details that may be of interest have been brought into use in these designs.

The throttle shown in Fig. 6 is provided with a steam separator at the extreme top, where the steam enters in an upward direction and after entering meets a sharp turn downward whereby the entrained water is thrown against the curved walls of the crown, is entrapped at its base and forced down through a central passage back to the boiler by the inertia exerted in the trap. The continuous current of moisture that is abruptly arrested allows no chance for the water particles, once brought into contact with the curved wall of the crown, to escape the trap. The steam in relieving itself from the moisture makes the turn into the valve opening directly at the top and through the valve body to the lower openings as will be seen from the cut.

Following the course of the steam, we do not meet any unusual construction of the passages until we reach the intercepting valve which, although not specially designed for this engine, should be considered in this connection as a most important factor; as it controls the pressure for the receiver and low-pressure cylinders, supplies steam direct from the boiler at a proportional pressure to the large cylinders in starting, prevents this pressure backing up against the high pressure piston and makes it possible to increase the power of the engine about 20% at critical moments, by permitting the engine to be changed in such emergencies so as to work live steam in all cylinders with equivalent distribution of the work. With the exception of changing the engine into simple while under way, all its movements are automatic. This intercepting valve (Fig. 6) consists principally of two valves intimately combined, the one effecting the closing of the other; and a change valve by which the former is unbalanced in turning the engine into simple working when under way.

The main valve closes the receiver and prevents the reduced live steam pressure from backing up against the high-pressure piston in starting and working simple, and by closing the exchange valve the accumulation of exhaust from the high-pressure cylinders automatically opens the main valve to the low-pressure side of the receivers and simultaneously closes the admission and reducing valve, whereby the engine is changed into compound. The live steam admission and reducing valve has the form of a sleeve placed on the stem of the main valve; and, as seen in the cut, is allowed a limited longitudinal play to perform its double function. The third, or change valve, has two functions to perform and is operated by the engineman in emergencies; and is, therefore, known as the emergency valve. Its use is resorted to only when the engine is about to stall on a heavy grade or at a difficult starting place. The first function of this valve is to unbalance the intercepting and reducing valves so that the former cuts off the low-pressure side of the receiver; and the second function is that of an outlet valve for high-pressure cylinder exhaust steam in working simple, which later is led in an independent pipe to the stack.

The next features of importance are the ball joints in the receiver and exhaust pipe (Fig. 7) which are peculiar to this type of engine. They consist, Fig. 6, of ball bearings, gland and packing. The latter is made of eight ½-in. square rings of Vulcabeston or fibrous packings laid in pairs, in the middle of which a brass ring of an elongated diamond section is inserted. Being just the width of the packing space, this ring seals all joints in the packing rings proper and forces them tightly against the inside of the box and against the ball.

The flexible exhaust pipe has two ball joints and one slip joint, as it is subject to a greater angle of deflection and elongation than the receiver pipe, which has its ball joint in the vertical center line of the pivot pin between the two sets of engines.

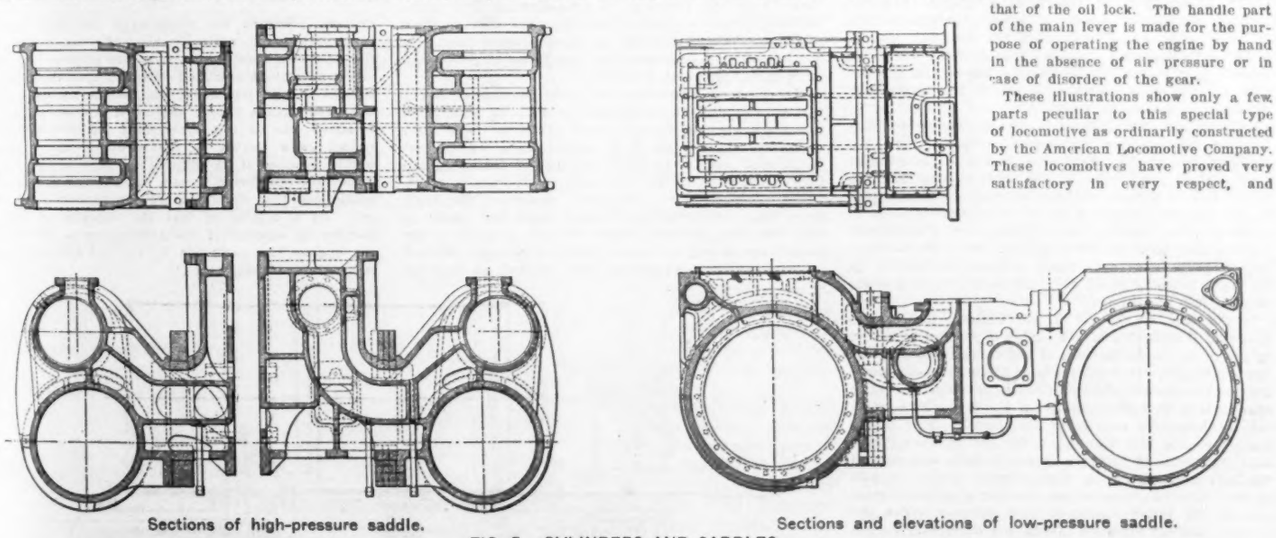
The valve motion in each set of engines is of the Walschaert type, driven by the respective main axles and crossheads and operated with a common reversing gear which simultaneously changes the motion of all the valves. Because of the lateral motion of the front engine in curving, means must be provided for flexibility in the operating gear so that this movement does not interfere with the motion of the valves. This is accomplished by using an exceptionally long lifting link, shown in Fig. 8, having a double jaw in its upper end and a universal joint or ball bearing at the radius bar, which allows its lower end to follow the movement of the engine transversely relatively to the rear engine, as well as the longitudinal movement of the valve in any angularity of the engine within the required limit of the swing.

The valve gear is operated by a hydro-pneumatic reversing mechanism, Fig. 9, consisting of one air and one oil cylinder, with the common piston rod connected to the main reversing lever. On a suitable location on the main lever is pivoted a second lever for operating the gear. A forward movement of this lever throws its lower end backward, turning the valves of the air and oil cylinder and thus making communication with the rear end of the air cylinder for air pressure to force the piston forward and, with it, the entire gear. The oil cylinder serving as a lock and regulator has, by this movement, established communication between both sides of its piston, allowing the latter to follow the movement of the gear, to which it gives a moderate and uniform motion because of the contracted passage for the oil through the valve. By stopping the movement of the operating lever, the gear moves the main lever up to the given relation to the former; and then, automatically, shuts off the air supply and locks the oil cylinders.

In unlatching the operating lever, the same movement raises the main latch which cannot drop until again in the given relation to the former, when the valves of both air and oil cylinders are closed and a positive locking of the gear is secured in addition to that of the oil lock. The handle part of the main lever is made for the purpose of operating the engine by hand in the absence of air pressure or in case of disorder of the gear.

These illustrations show only a few parts peculiar to this special type of locomotive as ordinarily constructed by the American Locomotive Company. These locomotives have proved very satisfactory in every respect, and have practically become a standard with these builders, but are of course subject to variations as may suit various service conditions. The most striking variation in any of these details is probably the intermediate draft coupling of this type of locomotive turned out by the Baldwin Locomotive Works, shown in Fig. 10, where a lateral play is provided for, and the draft pin is held in a central position by a series of springs.

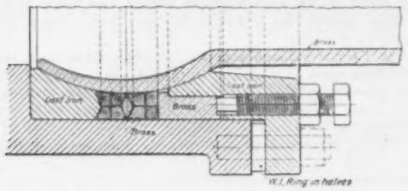
With the exception of some articulated engines built by them for service in Porto Rico in 1904, the first of this type built by the Baldwin Locomotive Works were those constructed for the Great Northern Railway, the pivot connection of which is shown in Fig. 10. Of this



Sections of high-pressure saddle. Sections and elevations of low-pressure saddle.

FIG. 5. CYLINDERS AND SADDLES.

design 67 engines are now in service on the Great Northern, 8 on the Chicago, Burlington & Quincy and 16 on the Northern Pacific. These engines are giving universal satisfaction and the present number is the result of repeat orders without any change whatever in design. These builders have also excluded the use of by-pass valves, double ported slide valves, and the intercepting valve in their cylinder construction, the starting being effected by simply letting live steam into the receiver.



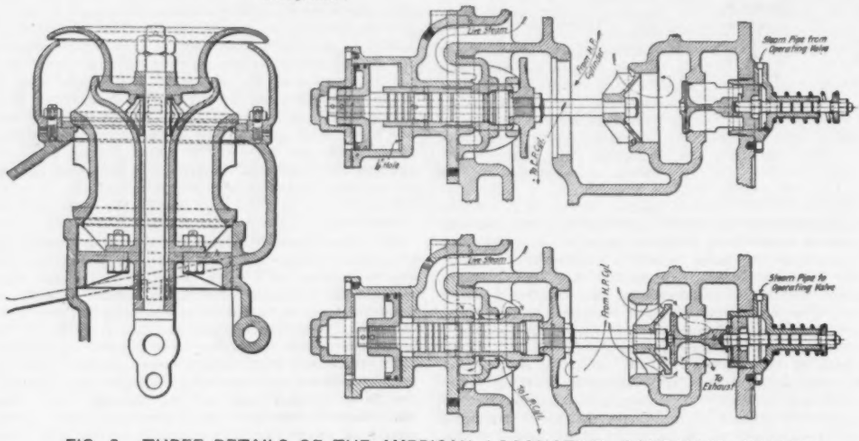


FIG. 6. THREE DETAILS OF THE AMERICAN LOCOMOTIVE COMPANY'S MALLET LOCOMOTIVE DESIGNS.

(Steam-separating throttle-valve, intercepting valve and ball joint in receiver pipe.)

SUPERHEATING.—The question of superheating the steam in connection with this type of locomotive has been considered practically from the outset. Superheating would further increase the efficiency of the engine, but it has so far been deemed advisable to leave it off, to avoid complications until this type becomes more generally known. Fig. 11 illustrates a design of Mallet locomotive prepared in accordance with instructions from Mr. Kendrick, Vice-President of the Atchison, Topeka & Santa Fe Railroad, now being constructed under his patents by the Baldwin Locomotive Works. In this design a combustion chamber, which is also fitted with superheater device, is used.

REDUCTION OF SLIPPING.—Among the various differences between the articulated compound and the ordinary type is the action when loaded to the slipping point. While the former is less liable to slip than the latter, due to a more uniform pressure on the pistons, it will not be considered loaded to anywhere near its capacity until slipping takes place, and consequently slipping does occur on heavy grades. With the ordinary engine, slipping at such times is a serious matter, as the train is losing speed and may stall on that account after a few repetitions.

In the case of the articulated engines, the loss in power by the slipping of one engine is practically gained by the other, in the increase of unbalanced pressure that thereby results. This difference in the unbalanced pressure has the opposite effect on the slipping engine, usually causing it to stop slipping after a few revolutions, without the necessity of closing the throttle. This is explained by the fact that, when the low-pressure engine slips, the receiver pressure naturally falls and reduces the back pressure on the high-pressure piston, as well as the forward pressure on the low-pressure piston, causing the latter engine to stop slipping under the reduced receiver pressure. When the high-pressure engine begins to slip, the receiver pressure increases by the more rapid supply of steam, and with this the back-pressure on the high-pressure piston is increased, causing the latter engine to resume its grip on the rail, and the power of the low-pressure engine is increased until normal power is restored in the high-pressure engine.

It is further to be noticed, that a simultaneous slipping of both engines is a very rare occurrence, due to the fact that there is one position of the crank where the turning effort is greater than in other positions, and this is where the slipping generally starts, at irregular intervals of revolutions, depending on the condition of the engine as necessity for repairs. If the wheels are of a very close approximation to the same diameter and running on a straight track, these intervals are longer, because the opposition between the wheels requiring re-adjustment is less frequent than when the wheels are unevenly worn. In either case, there is the greatest liability for this adjustment in the neighborhood of the greatest turning moment, say every fourth or fifth revolution, in normal rail condition. There being two independent engines, the coincidence of these conditions is very infrequent. The slipping of one engine may follow that of the other due to the temporary increase in power, but one is seldom found to start slipping before the other has stopped slipping, and it can therefore be said without much exaggeration that this type of engine is in effect a non-slipping engine.

When working live steam in all cylinders, generally known as working simple, the slipping is even less perceptible, although over 20% more power is developed; because the live steam supply to the low-pressure cylinders and the direct exhaust from the high-pressure cylinders are restricted to a very moderate piston speed. From the beginning of the slip, the low-pressure piston gets a rapid motion which causes a sudden fall in the pressure, and the slip generally stops after a few inches movement of the piston, under normal weather and rail conditions. The restricted supply port being fully open, however, the pressure is restored practically simultaneously with the stopping of the slipping. The high-pressure engines are not so sensitive; but after a couple of exhausts under slipping, the wheels regain their grip on the rail with comparatively small loss of power and in a period of short duration.

The effect on cars and draft gears in starting heavy trains by this type of engine, as well as convertible compound engines on the same principle, is a most important feature, as it is accomplished with a so-called dead pull, without the necessity of taking advantage of the slack in the train with its destructive jerks. These locomotives are, therefore, easier on the draft gears than simple engines of half their size loaded to their full capacity. The reason for this is found in the great starting and emergency power, previously referred to, with which these engines are provided, so that the slack is taken up under very slow speed. This is generally done with light throttles. The front cars start successively under a slight acceleration of the engine, gradually going over to a retardation before the last cars get into motion, after which the engine is given full throttle. In other words, the train is stretched first and then it is started under direct power so that there need not be any but slight shocks or [illegible].

These engines are adaptable to a greater variety of conditions than the older types, rendering it possible to double the engine power on a given weight; and their advantages are most pronounced displayed on heavy grades and sharp curvatures. [illegible] a hundred locomotives of this type have been built to the present date in this country, ranging in weight on drivers from 106,000 lbs. to 410,000 lbs. and from 20,000 lbs. to 125,000 lbs. in tractive power. The largest of these is taking the place of three ordinary locomotives, in pushing service, and is doing its work very satisfactorily. Their success in freight service will undoubtedly lead to their adoption in passenger service; especially in certain localities to avoid double heading, as the Pacific type locomotive is practically the upper limit for one set of drivers. It, therefore, appears that further development will have to be in the flexible driving wheel base or articulated type. Mallet type locomotives for passenger service, fitted with re-heater between the high and low pressure cylinders and feed water heater in combination therewith, for the Atchison, Topeka and Santa Fe R. R., are now under construction at the Baldwin Works.

It should also be remarked that, due to absence of jerks and slack in starting, as well as the more uniform cylinder pressure, the stresses on the machinery and framework are considerably reduced; and, further, that the milder exhaust produces a less intense heat and a better utilization of it, all of which contribute to a reduction in the repairs of the locomotive as a whole, compared with a simple engine, if it were practical to construct one of this type. This has never been advanced as a feature to the credit of the articulated engine because it is difficult to give it any definite value; but is referred to as a reply to the often repeated supposition that these engines are hard to keep in repair. As a matter of fact the opposite is the case, because on account of the subdivision of the work in two engines the parts are lighter and easier to handle in repairs and renewals.

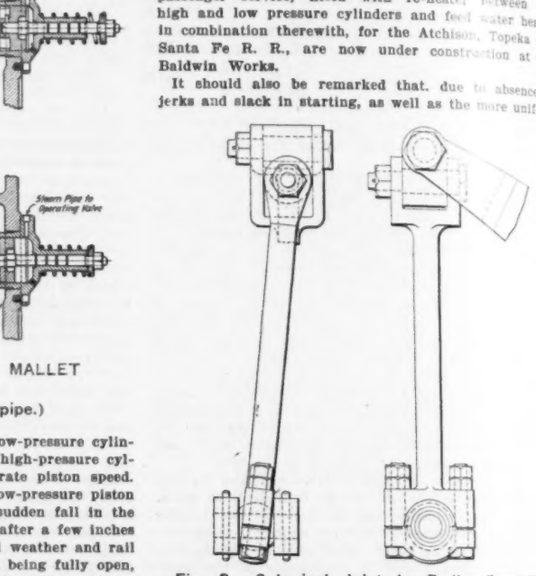


Fig. 8. Spherical Joint In Radius Bar Lifter.

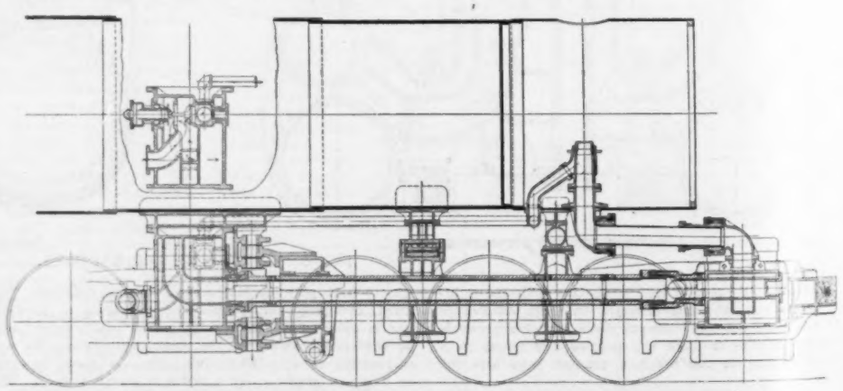


FIG. 7. LONGITUDINAL SECTION, SHOWING STEAM PIPES.

One of the fundamental principles in locomotive engineering, as applied to conditions as they exist in the United States, is simplicity of construction. This has led to a general reluctance on the part of American

railroad officials to accept complications as long as they could avoid it. The tendency toward heavier trains has, however, made it necessary to supply units of larger hauling capacity than have heretofore been necessary anywhere in the world. For the most exacting freight service, locomotives are required which have entirely outgrown the possibilities of ordinary construction, in very much the same way as marine requirements have outgrown the types of propelling engines which were entirely satisfactory a generation ago. In fact, the demand for units of larger power compels special construction in order that the large units may be operated without damage to the track and structures, and to avoid increasing the size of the moving parts of the locomotive to a prohibitive point. The articulated locomotive represents the highest development in this branch of engineering and the development is sufficiently important to justify the presentation of the subject in its present stage before a body of engineers who have had much to do with the corresponding developments in stationary or marine practice.

For the data and illustrations contained in this paper, the writer wishes to express his indebtedness to the American Locomotive Company and to Mr. Samuel Vauclain, General Manager of the Baldwin Locomotive Works.

THE ANNUAL MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

The 29th Annual Meeting of the American Society of Mechanical Engineers was held at the Engineering Building, in New York City, last week, and was by general consent the most successful convention which the Society has ever held. The number of members in attendance broke all the Society's past records.

In addition to the technical work of the convention in the reading and discussion of papers, a large amount of time was devoted to excursions and sight-seeing. A very efficient local reception committee, under the chairmanship of Mr. H. F. Holloway, had charge of the entertainment of out-of-town members and guests, and its courtesies were greatly appreciated by the visiting members. Among the notable excursions in which the vistors took part were visits to the new Queensborough and Manhattan Bridges across the East River; the two newest skyscrapers, viz., the Singer Building and the Metropolitan Life Insurance Company's tower; for achievements in the opposite direction, downwards, there were visits to the new Pennsylvania Railroad tunnels under the North and East Rivers. Various manufacturing plants also opened their doors to the visitors.

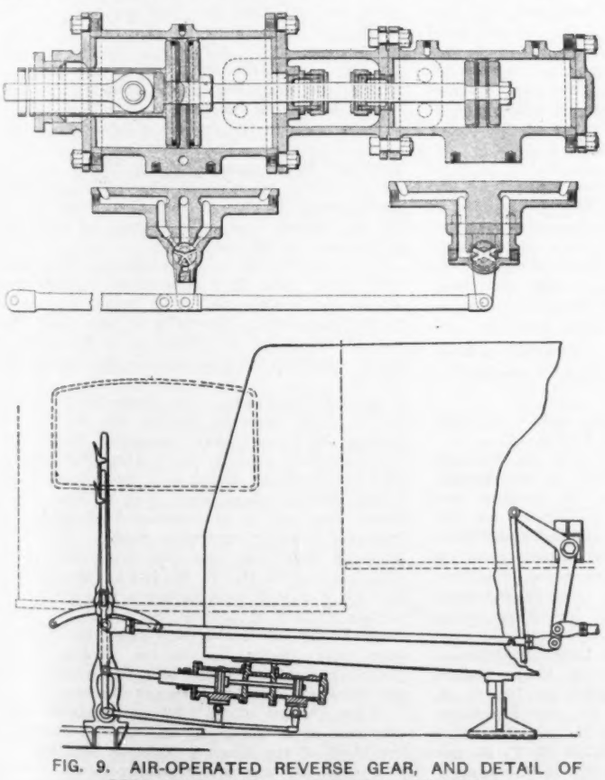


FIG. 9. AIR-OPERATED REVERSE GEAR, AND DETAIL OF OPERATING AND OIL-CUSHION CYLINDERS.

Contrary to the custom of previous years, no single afternoon of the week was given up entirely to excursions, the very full program of papers requiring steady work each morning and afternoon to complete the schedule. While this necessarily resulted in the absence of many members on excursions during the sessions, the attendance at the meeting was so large that all the sessions were well attended.

The opening session of the convention was on Tuesday evening. President M. L. Holman, of St. Louis, delivered the annual address, taking for his subject "The Conservation Idea as Applied to the American Society of Mechanical Engineers." President Holman represented the Society at the White House Conference last May, and his address was in part a report of that notable gathering, and in part a discussion of the position of the members of the Society with respect to the conservation question. Notable among his suggestions was the proposition that the law of water-rights should be revised so that the practice obtaining in the Far West, where beneficial use of water is the requirement for ownership and where riparian rights do not obtain, should be much more widely extended. In concluding his address, he made the novel suggestion that the Society should undertake the compilation and publication of an engineer's handbook for practical mechanical engineers.

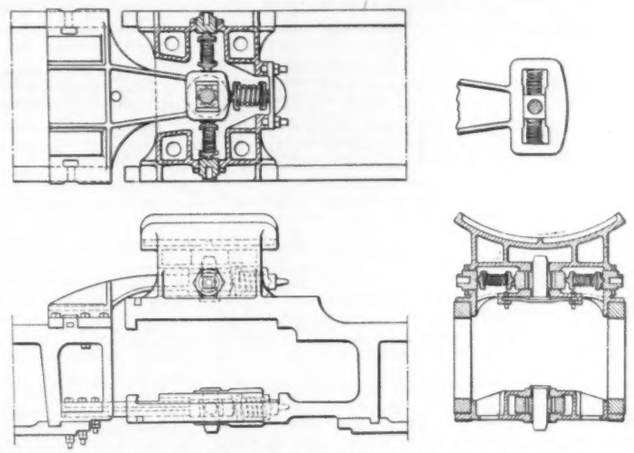


FIG. 10. BALDWIN LOCOMOTIVE WORKS' SPRING-CUSHIONED FRAME PIVOT CONNECTION FOR ARTICULATED LOCOMOTIVES.

Following this address came the conferring of honorary membership upon Dr. John A. Brashear, of Allegheny, Pa., the eminent physicist and mechanician. Professor Brashear gave an illustrated address before the Society at its Detroit meeting, last summer, on "Stellar Photography," and at the request of the Society he again addressed it upon the same subject, on Tuesday evening. The address was one of the most interesting and enjoyable ever delivered before the Society.

On Wednesday morning the regular sessions for professional papers began, the first one on the program having as its title "The Engineer and the People." Its author, Mr. Morris L. Cooke, of Philadelphia, urged that the profession owed a duty to the public and that this should be more clearly recognized by its members and by the professional organizations than has hitherto been the case. He gave many examples of cases where the services of the expert engineer would be of great value in preventing serious mistakes and loss in the administration of public affairs. Discussions upon Mr. Cooke's paper were contributed by President Hadley, of Yale University; by Frank Miles Day, of the American Institute of Architects, and by Talcott Williams, of Philadelphia, editor of the Philadelphia "Press." Mr. Williams' discussion was so novel and interesting that we print it in full as follows:

The suggestion in this paper is the natural and fortunate product of the joint experience of the mechanical engineer and journalist. Mr. Cooke has pointed out why the calling which gives this age its crowning difference from other ages, has less weight in public affairs and on public opinion than any other. Engineering creates modern life. Take away engineering, and we are what our predecessors were. Add engineering, and the modern world is.

Yet this creation pays less attention to the word of its creator than to any other factor in its daily being. What engineer has not seen money wasted to-day or waste made sure in the near future, in some public work or design for lack of engineering advice. The contractor overrides the engineer. The builder gets the better of the designer. The politician controls the technician. When I became a reporter, nothing amazed me more, after I had read in the technical journals of the brilliant skill with which some engineer had made the impossible possible, than to go to report the "opening" and find everybody on hand and sometimes everybody's name on the work, save the one man, who had made the work famous, but not himself known. Somewhere in the back of the platform, if he was lucky enough to get there, strolling uneasily around, unnoticed, was the man who had a right to say: "I am it." As Proverbs has it, when the poor wise man had "saved the city," no man "regarded his name."

The army engineer officer, it is true, rarely has to suffer this. He has his full share of the limelight. But there are several hundred civilian engineers working on government jobs, some of them of great ability, as we know who read behind and see through the official reports, who have not the position, recognition or pay, their work calls for. Would it be possible for these men, some grown gray in government service, to stand where they do, if engineering as a calling, had the public ear and attention Mr. Cooke urges and proposes to secure? Is it not true, that the engineer oftener than any other highly educated man sees

> "Art made tongue-tied by Authority,
> And Folly, doctor-like, controlling skill."

The engineer has the disadvantage of a silent profession. Much of his work is incomprehensible to the average man. How few men, not engineers, can read with comprehension the two recent reports on the failures of two great bridges at Quebec and New York? It is true of most engineering problems and their solution, that even the educated man, much less the mass of men, can only understand results. The engineer who secures these results, as I have already pointed out, too often fails to get credit. Failing to get credit, he fails to have weight with the community, which blunders and wanders for lack of his guidance.

The time of a good engineer is too valuable to civilization to be used up in mere personal agitation. There is, besides, something in the engineer's training which makes him an intellectual aristocrat; what he knows, he knows. He loathes personally putting himself forward. He is not made that way. Words are not his tools.

The practical result is that there is no class at once so able and so silent. None so visible in its work and so invisible in its personalities. There is to-day no body

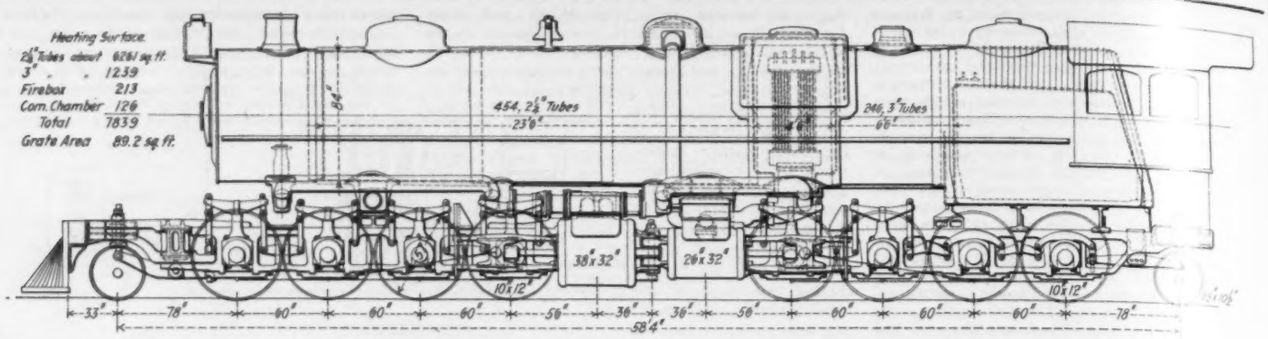


FIG. 11. GENERAL ELEVATION OF SUPERHEATED STEAM LOCOMOTIVE OF MALLET TYPE.

(Now being built for Atchison, Topeka & Santa Fe R. R. by Baldwin Locomotive Works.)

Gage of track	4 ft. 8½ ins.	Working pressure	215 lbs.	Driving wheel base	30 ft. 2 ins.
Diameter of cylinders	h. p. 25 ins.; l. p. 39 ins.	Length of firebox	126 ins.	Rigid wheel base	14 ft. 3 ins.
Stroke of piston	28 ins.	Width of firebox	114 ins.	Total weight in working order	410,000 lbs.
Diameter of driving wheels	51 ins.	Number of tubes	404	Weight on driving wheels	410,000 lbs.
Outside diameter of boiler at front end	84 ins.	Outside diameter of tubes	2¼ ins.	Tractive power	94,800 lbs.
(Boiler fitted with combustion chamber.)		Length of tubes	21 ft.	Tractive power, working simple	120,000 lbs.
				Factor of adhesion	4.33

of men, knowing so much, which influences public opinion so little. Who of you does not know of engineering blunders and engineering wastes because the large public of voters and the small public of directors are ignorant of what has been done in engineering? Both are ignorant because your profession does less than any other, to educate the public. Look at the work for public health done by doctors, for new laws by lawyers, by my own calling in awakening the public.

The engineer will never stand where he should in the modern state, until he, too, discharges his duty at this point. The doctor has his societies. The lawyer his associations. Are your societies doing their share? Neither doctor nor lawyer speaks individually. Nor need the engineer. Let local and national engineering societies speak.

Take the stationary engine. We all know that it is in this country insufficiently protected against injuring and maiming and killing those at work about it. Some day you will face a fool law on these and other points of danger, hampering all your work as mechanical engineers. Why ought not your societies to guide and frame the laws we are sure to have to make our engines and machines safer?

A large concrete construction collapsed in Philadelphia not long ago, slaying helpless men, because a contractor found it easier to steal professional plans than to hire professional skill. Suppose on the heels of that disaster a Philadelphia society of engineers had spoken through the newspapers clearly, emphatically and authoritatively? Was this not as much their duty as for a medical society to deal with deaths from pestilence?

Each year our state legislatures have before them dubious legislation on engineering issues. Some is sentimental ignorance. Some is ignorant sentiment. Some is sheer "strike." Some is wise. Medical societies take up medical laws. Legal committees and associations educate the public on their subjects. Why should not state and city engineering societies have their committees on legislation? The newspapers will always gladly print this collective, authoritative opinion. They worry you now, individually, for half-baked verbal utterances, hastily given and inaccurately reported.

If failures in construction or in design in public work had lucid, authoritative exposition from engineering societies, if legislation were followed, if expert remedies were proposed by engineers for known evils, the public would come to look to these engineering societies for advice; and so looking, the entire status and position of the engineer would change. He would have the weight he should have as the maker of our current civilization, because he would be doing his duty in educating the great public, our sovereign, yours and mine, our larger self.

The next subject on the program was a paper on "Military Aeronautics," by Major George O. Squier, Acting Chief Signal Officer, U. S. A. The paper was the first presentation of what may be termed the "engineering of aeronautics" before one of the national engineering societies, and was of such interest that we have printed it nearly in full in the present issue. A similar review of the subject, but in a more popular vein, was delivered in the evening by Lieut. Frank P. Lahm, of the Signal Corps, U. S. A. Lieut. Lahm has won fame as an aeronaut, having captured the James Gordon Bennett Cup in the International Balloon Race of 1906. Popular interest in the subject of aeronautics was evidenced by the crowd which filled the auditorium to hear Lieut. Lahm's lecture. For the first time since the building was opened, this large auditorium was filled to overflowing, every seat being taken and the entire rear of the hall being occupied by those standing.

STEAM AND POWER-PLANT PAPERS.—The professional session of Wednesday afternoon was occupied by four papers; two of these were highly theoretical and two were essentially practical.

Mr. A. R. Dodge, of Schenectady, N. Y., in the paper "A Method of Obtaining Ratios of Specific Heats," gave some details of a method of determining specific heats of superheated and saturated steam, the results of which have been previously reported. (Engineering News, June 6, 1907.) The results then published received such adverse criticism that the additional information was published.

Mr. H. N. Davis, Harvard University, said that he had been allowed to study Mr. Dodge's work and data at length and in detail, and that while it was a most stupendous and careful investigation there was an unexplained discrepancy of about 13° F. on the low-side temperatures. The most careful analysis of the theory and practices of the method had failed to locate the trouble.

"The Total Heat of Saturated Steam," by Mr. H. N. Davis, was a study of the classic data of Regnault on the total heat of saturated steam, as well as those obtained by more recent workers, such as Grindley (1900), Griessmann (1904), and Peake (1905). It was found that Regnault's accepted straight-line formula

$$H = 1091.7 + 0.305\ (t - 32)\ \text{B. T. U.}$$

was not as correct as the second-degree equation,

$$H = 1150.3 + 0.3745\ (t - 212) - 0.000550\ (t - 212)^2.$$

The range of this formula is from 212° to about 400° F., with an accuracy of 1/10 of 1%.

In discussing this paper, Prof. C. H. Peabody, of the Massachusetts Institute of Technology, said that the paper was to be accepted and that it was necessary to recompute all our steam tables. As far as practical uses were concerned, he showed, there was an error of only ½ of 1% in the middle range of total heat figures. The entropy tables recently published need only one correction that of quality (x) or dryness.

"Fuel Economy Tests at a Large Oil-Burning Electric Power Plant Having Steam-Engine Prime Movers," was contributed by Mr. C. R. Weymouth, of C. C. Moore & Co., San Francisco, Cal. This plant, in which the excellent fuel economy (about 24,000 to 26,700 B. T. U. per KW.) was attained, has 15,000 KW. capacity and is located at Redondo Beach, near Los Angeles, Cal. This plant and similar tests to those reported in this paper were described in Engineering News, Sept. 17, 1908.

The paper entitled "Unnecessary Losses in Firing Fuel Oil and an Automatic System for Eliminating Them," also by Mr. Weymouth, took up the details of the oil-firing system in the Redondo plant. Briefly an oil-pump governor is actuated by variations in the boiler pressure as the load varies. This governor does not regulate the main stream of oil fed to one panel of boilers but acts on a certain proportion which is by-passed. Therefore the greater fluctuations of load at different parts of the day must be taken care of by hand. The steam required to atomize the oil and the proper amount of air for good combustion are similarly operated from the pressure in the oil main.

A MACHINE SHOP SESSION.—While the American Society of Mechanical Engineers is largely made up of men interested in machine-shop work, a surprisingly small amount of data relating to such work has ever found its way into the Society's Transactions. To remedy this in some degree a special machine-shop session was arranged for this meeting, and this took place on Thursday morning. The first two papers were devoted to milling machine practice. The first, by Mr. A. L. De Leeuw, of Cincinnati, described some tests of the efficiency of milling machines and milling machine cutters made in the course of developing a new style of machine. The paper showed that a surprisingly large amount of the power absorbed by a milling machine is absorbed in the feed mechanism. It also showed that improvements in the cutting tools offer promise of great improvement in efficiency.

Mr. F. W. Taylor, of Philadelphia, in discussing this paper said that it needed a supplement giving the engineering work rather than mere accomplishments. Especially it was urged that something should be given as to the train of gears employed as that largely determined efficiency.

"The Development of a High-Speed Milling Cutter with Inserted Blades for High-Power Milling Machines" was presented by Messrs. Wilfred Lewis and W. H. Taylor, Philadelphia. This described the design of a cutter with blades whose cutting edges were true helices. Much stress was laid on the increased efficiency and improved quality of work made possible by pumping lubricant onto the tool. This point was attacked by Mr. F. W. Taylor, who claimed that for a cutting tool having a pressure at the cutting surface of 180,000 lbs. per sq. in. there could be no lubrication and that the improvement was wholly due to the cooling of the "lubricant." This view was not accepted by the many others who discussed the paper.

"Metal Cutting Tools Without Clearance" was the title of a paper by Mr. James Hartness, President of the Jones & Lamson Machine Co., of Springfield, Vt. Mr. Hartness is well known to mechanical engineers as the producer of the flat turret lathe. During recent investigations in connection with the work of lathes of this class, he has developed a new turning tool and holder which will cut absolutely without clearance. By the use of this tool it becomes possible to use a sharper cutting edge and thereby to considerably reduce the pressure upon the

tool. The paper gave a careful detailed analysis of the operation of metal cutting tools, and will be studied with interest by all who are interested in machine-shop practice.

The two remaining papers at this session were devoted to gearing. In the first, Mr. Ralph E. Flanders, of New York, urged that a new form of tooth should be developed and standardized for certain types of heavy slow-speed gearing. The second paper, by Mr. Norman Litchfield, of New York, described practice with the spur gearing on heavy railway motor cars used in the New York Subway. The paper is printed elsewhere in this issue.

The discussion on the machine-shop papers was so active and developed so much interest that the morning session was not sufficient to complete it, and a special session was held in the afternoon for those who desired to continue the discussion further. As a session of the Gas Power Section of the Society was also scheduled for the afternoon, there were, for the first time in the history of the Society, three sessions for the reading and discussion of papers in progress simultaneously. It may be added that so much interest was taken in the machine-shop session that preliminary steps were taken looking to the organization of a special section of the Society to be devoted to machine-shop practice.

GAS POWER SECTION.—Only two papers were presented at the single session of this section, the most of the time being consumed by business and committee affairs. Mr. T. R. Lull was elected President of the section and Mr. G. A. Orrok Secretary. As an addition to the work of the Standardization Committee, Prof. L. S. Marks, Boston, offered a discussion on the relation of hydrogen content to the heating value of a coal.

In "Reminiscences of a Gas-Engine Designer," Mr. L. H. Nash, of the National Metal Co., New York, described some of the peculiar lines of invention on which he had worked in earlier years.

Prof. F. C. Wagner, Terre Haute, Ind., in "Some Possibilities of the Gasolene Turbine," took up the theoretical advantages of a prime mover where the gas was burned to complete combustion, expanded in a nozzle of refractory material and thrown in contact with a velocity-type turbine wheel. The author believed that a reliable and efficient prime mover could be developed on these lines. This paper was reprinted in Engineering News Dec. 3.

PAPERS OF EXPERIMENTAL DATA.—"The Physical Properties of Carbonic Acid and the Conditions of Its Economic Storage for Transportation," by Prof. R. T. Stewart, Pittsburg, was presented by the author as a complete monograph on the physical properties of this gas and on the design of cylinders to contain it. It was claimed that the present cylinders were a source of considerable danger and that all cylinders should be designed to provide certain contingencies. The general opinion of the discussion was that the author had greatly overestimated the danger, as shown by accident reports. It was generally held that contingencies likely to cause tank explosions should be cared for by safety devices rather than by the design of the tank.

"The Slipping Point of Rolled Boiler-Tube Joints," by Profs. O. P. Hood and G. L. Christensen, Houghton, Mich., showed the results of studies on the behavior of rolled boiler-tube joints. The scope of the paper is shown by the authors' conclusions.

(a) The slipping point of a 3-in. 12-gage Shelby cold-drawn tube rolled into a straight smooth machined hole in a 1-in. sheet occurs with a pull of about 7,000 lbs. (b) Various degrees of rolling do not greatly affect the point of initial slip. (c) The frictional resistance of such tubes is about 750 lbs. per sq. in. of tube-bearing area in sheets ⅝-in. and 1 in. thick. (d) For a higher resistance to initial slip other resistance than friction must be depended upon. (e) Serrating the tube seat in a straight machined hole by rolling or cutting square edged grooves about 0.01 in. deep and ten pitch will raise the slipping point to three or four times that in a smooth hole. (f) It is possible to make a rolled joint that will offer a resistance beyond the elastic limit of the tube and remain tight.

Col. E. D. Meier, New York City, in the discussion, pointed out the necessity of preventing any traces of oil in the rolled joint, whether smooth or not, in order to prevent lubrication and early slip.

In "Test of Friction Clutches," Prof. R. G. Dukes, Cleveland, O., described a half dozen of the types of machine-shop or power-transmission friction clutches found on the market, and gave the data from tests of them to determine maximum capacities and maximum loads picked up.

Prof. W. F. Durand, Leland Stanford University, in "An Averaging Instrument for Polar Diagrams," described a sort of plainmeter for obtaining the mean value of pressure, temperature, voltage, etc., as recorded on a revolving-dial recorder.

MISCELLANEOUS PAPERS.—Five papers, on various subjects, were scheduled for the regular session on Thursday afternoon. The first of these was by Mr. Amasa Trowbridge on "Liquid Tachometers." This is a speed-recording instrument which has been developed by the Veeder Manufacturing Co., of Hartford, Conn., and operates on the principle of the centrifugal force developed in a liquid when rotated at a certain speed. The pressure due to this speed forces the liquid up an indicating tube. Speed indicators on this principle have been developed which are suitable for use on automobiles and locomotives.

Following this came a paper which attracted as much attention, perhaps, as any presented at the convention, to wit, "Training Workmen in Habits of Industry and Cooperation," by Mr. H. L. Gantt, of Pawtucket, R. I. Mr. Gantt has been for many years engaged in the reorganization of factory plants, to place them on the so-called bonus system of payment to workmen. Special features of this bonus system are the systematic instruction of the workers and the careful setting of tasks. The paper was declared by those who took part in the discussion to be one of the most important presented at the convention. In a later issue we shall present a summary of the paper and the discussion upon it.

The next paper, by Mr. George B. Wilcox, of Saginaw, Mich., had for its subject "The Manufacture of Salt." It described some features of modern brine evaporating plants, which are likely to be useful to engineers engaged in other branches of industry.

The paper on "Industrial Photography," by Mr. S. A. Hand, which was printed in our issue of Nov. 19, was then presented with lantern slide illustrations. The subject is a novel one in engineering literature, and the details of practice presented are of much practical usefulness.

The final paper of the session was by Mr. C. J. Mellin, Designing Engineer of the American Locomotive Co., and described the recent practice with the Mallet articulated compound locomotive in this country. The paper is reprinted elsewhere in this issue. Mr. S. M. Vauclain, of the Baldwin Locomotive Works, discussed the paper, showing various locomotives of this type which his firm had designed and built.

On Thursday evening the regular annual reception was held in the Engineering Societies Building. The guests were received in the Society's headquarters, on the eleventh floor, by the retiring and incoming presidents and other officers of the Society.

ANNUAL MEETING OF THE AMERICAN SOCIETY OF REFRIGERATING ENGINEERS.

The fourth annual meeting of the American Society of Refrigerating Engineers was held Nov. 30 and Dec. 1 at the Engineering Societies' Building, New York City. At the business session the following officers were elected: President, Lewis Block, New York City; Vice-President, Homer McDaniel, Cleveland, Ohio; Treasurer, Walter C. Reid, New York City. Directors, Madison Cooper, New York City; N. H. Hiller, Carbondale, Pa.; W. H. Manus, Waynesboro, Pa.

At the first technical session Mr. J. C. Sparks (New York City) read a paper on "The Relative Bacteriological Contents of Can, Plate and Natural Ice Under Various Conditions." The author pointed out the infection of ice shown by local and federal investigations of many "hygeia" ice manufacturing companies. This was attributed to improper sanitation of the premises.

"Ethyl Chloride Refrigeration" was the title of a paper, by C. C. Palmer (New York City), taking up the properties of this agent, a neutral product of grain alcohol and hydrochloric acid gas. The arrangement of the machinery necessary to work this agent under a partial vacuum was taken up in a general way.

In "The Construction and Actual Results Obtained from an Ice Making Plant of Moderate Size," Mr. Chas. Dickerman (Philadelphia) described the arrangement and operation of a small plant which "some might consider modern and some ancient enough for a junk pile," as the author described it.

One session had for its main topics, waterproofing and concrete tanks. The paper on "Reinforced-Concrete Freezing Tanks," by Mr. W. M. Torrance, is reprinted, with discussion, on p. 641 of this issue. Mr. Edward W. De Knight developed his well-known theory of the "membrane" method of waterproofing as an adjunct to refrigeration, in a paper entitled "Waterproofing in Refrigerating Work." He maintained that as insulation is the "very corner-stone of successful refrigeration," and as there can be no insulation where water penetrates, it is absolutely necessary for every refrigerating unit to be amply waterproofed. This being granted, then the only way to guarantee insulation is to provide some exterior impervious and elastic coating which will prevent the passage of water and will also preserve its integrity under any movement or abrasive action.

In "Standard Method of Testing Refrigerating Machines," Prof. D. S. Jacobus (Stevens Institute) presented the ideas expressed at meetings of the American Society of Mechanical Engineers and at the International Congress of Refrigerating Industries as to the advisability of imposing standard conditions for the performance of this class of apparatus. He advocated the formation of a joint committee with the American Society of Mechanical Engineers to consider units and conditions. Such a committee, representing the refrigerating engineers, was elected as follows: J. E. Starr (New York City), Lewis Block (New York City), Thomas Shipley (York, Pa.), W. E. Parsons (New York City), F. E. Matthews (New York City).

The paper "Performance of Ammonia Compression Machines," by Prof. C. E. Lucke (Columbia University), was a careful and lengthy analysis of the results of a series of comparative tests at the Rochester works of the Eastman Kodak Co., on a refrigeration machine equipped with a "De La Vergne" oil compressor, for one series, and with two "York" single-acting compressors for the other series. The Eastman Co. hoped to test the hostile contentions of the two classes of apparatus. The result of the long analytical discussion was "nothing proven." Such a view was, of course, disapproved by Mr. Thos. Shipley, representing the makers of the "York" apparatus.

"Does Ammonia Disintegrate in Absorption Plants?" This query which arises annually, Mr. Herman Dannenbaum (Philadelphia) answered in the negative, stating that the foul gases generally accumulating in holders were largely hydrogen and that they were due probably to the decomposition of the water.

"Refrigeration Applied to Air Supply for Blast Furnaces," by Mr. Bruce Walter (Pittsburg) was a discussion of this comparatively recent development in the metallurgy of iron. Formerly, while great attention was paid to measuring, fuel, ores, etc., it was stated that the air required for a run was measured by the piston displacement of the blowers without regard to moisture content or temperature. In 1897 the Carnegie Steel Co., under the supervision of the late James Gayley began to study the problem of providing dry air at definite temperature under all weather conditions. The first practical dry-blast plant was begun in 1903 at the Isabella plant of the U. S. Steel Corporation and was designed to furnish 40,000 cu. ft. per min. There are now four other plants in successful operation. In addition to more advantageous working of the metal, there is an appreciable decrease in the cost of making pig iron.

Mr. H. G. Powell, U. S. Department of Agriculture (Washington, D. C.), told of the "Investigations in the Handling of Perishable Products."

Briefly it may be said that precooling after packing, but before transportation had the effect of decreasing the amount of spoiled fruit on arrival at the destination. This loss was found due to the entrance of decay organisms through bruises given in picking, and if proper care was taken in picking and handling to prevent bruising more benefit was obtained than by expensive precooling. These remarks were largely confined to the California products, especially to the citrus fruits. They were held to apply to a considerable degree to the grapes, which California is raising in increased amounts, except that these are more tender and inherently shorter lived than the citrus fruits.

THE EFFECT OF CALCIUM ALUMINATE ON VARIOUS LIME AND NATURAL CEMENT MORTARS.

As a part of an extensive investigation into the effect of the addition of separately prepared calcium aluminate to ordinary mortars Mr. Henry S. Spackman, of the H. S. Spackman Engineering Co., of Philadelphia, Pa., has made a considerable number of tension briquette tests.

The tests are abstracted below under seven separate heads, numbered consecutively from I. to VII. Under each heading is given the chemical composition of the various ingredients. In the accompanying table each of these separate tests is recorded under sub-letters as Ia, Ib, etc., the proportion of each ingredient used, the times of set and the tensile values for different intervals. All these strength tests are the standard tensile tests made with one part of the cementing mixture and three parts of Ottawa sand. Those briquettes marked "(air)" remained in the air until the time of breaking; those marked "(water)" were allowed to set one day in air and the balance in water. Each figure is the average of at least three briquettes.

I.—Shale from California, Hydrated Lime and Calcium Aluminate.

	Shale. %	Calcium aluminate. %	Hydrated lime. %
Silica (SiO_2)	69.02	1.16	1.02
Alumina (Al_2O_3)	5.31	62.41 }	.42
Iron Oxide (Fe_2O_3)	2.35	4.51 }	
Lime (CaO)	6.22	31.46	73.58
Magnesia (MgO)	3.12	.72	1.12
Loss on ignition	11.96	.02	23.66

II.—Clay from Wisconsin, Hydrated Lime and Calcium Aluminate.

	Clay. %	Aluminate. %	Hydrated lime. %
Silica (SiO_2)	68.84	1.16	1.02
Alumina (Al_2O_3)	12.07	62.41 }	.42
Iron Oxide (Fe_2O_3)	7.17	4.51 }	
Lime (CaO)	1.16	31.46	73.58
Magnesia (MgO)	1.37	.72	1.12
Loss on ignition	9.54	.02	23.66

This was rather coarse grained field clay containing more sand.

III.—Finely Ground Sandstone, Hydrated Lime and Calcium Aluminate.

	Sandstone. %	Calcium aluminate. %	Hydrated lime. %
Silica (SiO_2)	90.26	1:16	1.02
Alumina (Al_2O_3) }	3.82	62.41 }	.42
Iron Oxide (Fe_2O_3) }		4.51 }	
Lime (CaO)	.60	31.46	73.58
Magnesia (MgO)	.42	.72	1.12
Loss on ignition	.90	.02	23.66

The sandstone was ground to a fineness of 92% on a No. 200 sieve.

IV.—Calcium Aluminate and Trass and Lime Mortars.

The materials used in the investigation were trass from D. Zervas & Son, Cologne, Germany, and high calcium hydrated lime and calcium aluminate made in the laboratories of the Henry S. Spackman Engineering Co., Philadelphia, Pa.

These materials were found to contain:

Trass.	%	Hydrated Lime.	%
Silica (SiO_2)	55.62		
Alumina (Al_2O_3)	22.06		
Iron Oxide (Fe_2O_3)	1.63	Silica (SiO_2)	1.02
Lime (CaO)	1.82	Alumina (Al_2O_3) }	.42
Magnesia (MgO)	.54	Iron Oxide (Fe_2O_3) }	
Soda (Na_2O)	6.01	Lime (CaO)	73.58
Potash (K_2O)	1.71	Magnesia (MgO)	1.12
Loss on ignition	10.16	Loss on ignition	23.66

Calcium Aluminate.

	%
Silica (SiO_2)	3.40
Alumina (Al_2O_3)	45.16
Iron Oxide (Fe_2O_3)	12.80
Lime (CaO)	35.40
Magnesia (MgO)	2.72
Loss on ignition	.64

TABLE SHOWING STRENGTHS OF VARIOUS MIXTURES WITH CALCIUM ALUMINATE AN[illegible]YDRATED LIME IN MORTARS.

Percentage of Mixture.

	High Calcium Lime.	Magnesian Lime.	Calcium Aluminate.	Hydrated Lime.	California Shale.	Wisconsin Clay.	Sandstone.	Trass.	Burned Cement Rock.	Natural Cement.	Plaster of Paris.	Set: Initial h.m.	Set: Final h.m.	Tensile in 115 [illegible]: 24 hrs.	7 dys.	28 dys.	3 mos.	12 mos.
(Water) Ia	..	..	12	45	40	..	..	..	..	..	3	2 00	4 00	78	106	30[illegible]	[illegible]	..
(Water) Ib	..	..	12	29	59	..	..	..	..	..	..	....	....	..	105	25[illegible]	[illegible]	..
(Water) Ie	..	..	33⅓	33⅓	33⅓	..	..	..	..	..	..	0 35	1 15	..	225	31[illegible]	[illegible]	..
(Water) II	..	..	7	55	..	35	..	..	..	..	3	1 30	4 30	..	93	13[illegible]	[illegible]	..
(Air) II	..	..	..	..	..	..	..	..	..	..	..	1 30	4 30	..	115	16[illegible]	[illegible]	..
(Water) III	..	..	10	55	..	..	35	..	..	..	..	2 50	8 00	..	72	5[illegible]	[illegible]	..
(Air) IV	..	..	..	..	..	..	..	..	..	..	..	2 50	8 00	..	101	15[illegible]	[illegible]	..
(Water) IVa	..	..	10	30	..	..	..	60	..	..	..	....	....	25	145	28[illegible]	[illegible]	..
(Water) IVb	..	..	10	45	..	..	..	45	..	..	..	....	....	58	208	30[illegible]	[illegible]	..
(Water) IVc	..	..	..	66⅔	..	..	..	33⅓	..	..	..	....	....	..	58	20[illegible]	[illegible]	..
(Air) Va	93	..	5	..	..	..	..	..	..	..	[illegible]	....	....	..	50	12[illegible]	[illegible]	..
(Air) Vb	88	..	10	..	..	..	..	..	..	..	[illegible]	....	....	..	82	15[illegible]	[illegible]	172
(Air) Vc	..	88	10	..	..	..	..	..	..	..	[illegible]	....	....	..	68	13[illegible]	[illegible]	182
(Air) Vd	..	93	5	..	..	..	..	..	..	..	[illegible]	....	....	..	37	7[illegible]	[illegible]	188
(Air) Ve*	88	..	10	..	..	..	..	..	..	..	[illegible]	....	....	..	101	94	[illegible]	170
(Water) Vf	90	..	10	..	..	..	..	..	..	..	[illegible]	....	....	..	5	38	[illegible]	..
(Water) Vg	80	..	17	..	..	..	..	..	..	..	[illegible]	....	....	..	62	105	[illegible]	..
(Water) VIa	..	..	5	5	..	..	..	..	..	90	[illegible]	1 00	1 30	203	358	458	[illegible]	..
(Water) VIb	..	..	10	10	..	..	..	..	80	..	[illegible]	....	....	..	375	500	[illegible]	..
(Water) VIIa	..	..	5	5	..	..	..	..	..	90	2	1 14	2 9	103	201	315	[illegible]	..
(Water) VIIb	..	..	10	10	..	..	..	..	..	80	[illegible]	....	....	106	206	312	[illegible]	..

*Same as Vc, except that a better calcium aluminate was used.

V.—Addition of Calcium Aluminate to Hydrated Limes.

	Calcium Aluminate %	High Calcium Lime %	Magnesian Lime %
Silica (SiO_2)	9.14	2.77	2.30
Alumina and Iron Oxide (R_2O_3)	56.80	0.99	0.92
Lime (CaO)	31.32	70.67	43.34
Magnesia (MgO)	.80	1.38	29.46
Loss on ignition	2.08	24.10	24.14

VI. Calcium Aluminate and Calcined Rock. Analysis:

	Natural Cement %	Aluminate %	Hydrated Lime %
Silica (SiO_2)	22.22	1.16	1.02
Alumina (Al_2O_3)	9.90	62.41 }	0.42
Iron Oxide (Fe_2O_3)	2.63	4.51 }	
Lime (CaO)	54.72	31.46	73.58
Magnesia (MgO)	2.92	0.72	1.12
Loss on ignition	5.74	0.02	23.66

The natural cement was received in the form of burned rock and to this was added 5 parts of aluminate, and 5 parts of hydrated lime. The material was then ground and 2 parts plaster of Paris incorporated therewith. This material when tested according to the standard specifications for cement gave the results shown in the table under VIa.

The cement was then mixed in the proportions of 80 parts calcined rock, 10 parts calcium aluminate, 10 parts hydrated lime, 2 parts plaster of paris. The results are shown under VIb.

VII.—Natural Cement.

The above tests were then repeated on commercial samples of natural cement to which was added the calcium aluminate and lime, six different samples being tested, tests being repeated on each sample at least twice and the total tests covered by the average is over 30. These were mixed in the proportions, by weight, of 90 parts cement, 5 parts calcium aluminate, 5 parts lime. To this mix 2 parts of plaster of paris was added. The average results obtained on this series of tests are shown under VIIa.

The same cements were then tested with the addition of 10 parts aluminate, 10 parts hydrated lime; 2 parts plaster of paris being added. The average of these tests is shown under VIIb.

The average of the cement as received tested in the ordinary manner was:

24 hours.	7 days.	28 days.	3 mos.
66 lbs.	119 lbs.	179 lbs.	289 lbs.

In connection with the experiments Mr. Spachman says:

The experiments show that very definite results were secured by using the aluminate with hydrated lime alone. The incorporation of the aluminate material with trass-lime compositions gave striking results and natural cements, also, are greatly improved in their early strengths, hardness, and resistance to abrasion by the use of a small percentage of the aluminate.

Tests were also made with aluminate prepared from bauxite and other materials, such as kaolin, high alumina clays, slags, etc., all of which were found to work in a satisfactory manner. The presence of considerable amounts of iron and silica not being found objectionable. In the tests given above, in order that they may be comparative, only those made with aluminate approaching the mono-calcic formula are given.

In view of the fact that the work is still in progress, no specific conclusions have been drawn at this time as to how the addition of the aluminate produces the striking results shown by the tests given. The tests, quoted, however, are typical and are borne out by the many other tests on similar materials made in the course of the extended investigation of the subject.

In every instance neat pats were subjected to accelerated tests in steam and boiling water and proved sound.

THE EXPLOSION OF A BAR MILL FURNACE in the Spang, Chalfant & Co. plant at Etna, Pa., fatally injured four men and about 20 others were seriously burned or wounded by flying debris. The mill had just commenced operations after having been shut down for more than four months. The explosion took place while the furnace was being charged.

FLOODS IN THE ARKANSAS RIVER at Pine Bluff, Ark., have undermined and damaged or destroyed a number of buildings on the water front, including the annex to the Jefferson County court-house. Some relief was afforded by blowing off a portion of a point in the river bank, opposite the city. Some of the river protection work at Pine Bluff is briefly mentioned in the course of a long letter by Mr. Chas. H. Miller, M. Am. Soc. C. E., which appears in our Letters to the Editor, this week.

AN ACCIDENT IN A BLAST FURNACE plant of the Toledo Furnace Co., at Birmingham, East Toledo, Ohio, Nov. 29, resulted in the fatal injury of three men, while two others were seriously burned. The high-pressure, hot-blast pipe of one of the furnaces suddenly burst and the stream of air, preheated to about 600° F., was turned upon the five workmen.

AN EXPLOSION IN A COAL MINE at Norwood, W. Va., Dec. 3, killed two miners and seriously injured two others. The accident occurred in the King mine and 13 men were in the mine at the time of the explosion. It is believed that the explosion was due to the ignition of gas, escaping from abandoned workings, by a blown-out shot. The mine is owned by the Tidewater Coal & Coke Co.

AN EXPLOSION IN A POWDER MILL at Maynard, Mass., Dec. 5, demolished the mill and killed two workmen, the only ones in the building at the time of the accident. The mill was the property of the American Powder Co.

A TYPHOON ON THE JAPANESE COAST wrecked 35 fishing boats Dec. 2 in Kawatsu Bay. It is reported that more than 300 fishermen were drowned.

TEN FISHING VESSELS WERE WRECKED on the Newfoundland coast in a storm which began Dec. 1 and lasted 48 hours. A northerly gale was accompanied by a heavy snow fall, causing the ships to lose their bearings. Reports state that 17 men were drowned.

A WATERFRONT FIRE AT PORTLAND, ME., completely destroyed two of the eight storage docks of the Grand Trunk Ry. and ruined a large amount of the freight on the adjacent docks. The steamship "Cornishman" of the Dominion Line was tied up at one of the docks and was heavily damaged before it could be towed out of danger. The total loss resulting from the fire is estimated at $600,000.

A HIGH AR TORE OUT A BRIDGE at Haverhill, Mass., on the evening of Nov. 25. A highway bridge approach crossing the Boston & Maine Ry. tracks by a timber span was wrecked by a furniture car of excessive height in a freight train passing below. Of the several persons on the span, none were injured; an electric car had passed over the span only a few minutes before the accident.

RAILWAY ACCIDENTS occurring between Dec. 3 and 5 resulted in the death of six persons and seriously injured twelve others. The "Memphis Fast Mail" on the Chicago & Rock Island Ry. was partially derailed Dec. 4 at Kerr Station, eleven miles east of Little Rock, Ark. The engineer and fireman were killed and two others were injured. The locomotive and the mail, baggage and chair cars were derailed, the locomotive and mail car being completely wrecked. The accident is ascribed to a defective switch.

The boiler of the locomotive of a freight train on the Erie R. R. exploded Dec. 4, six miles east of Mansfield, Ohio. The engineer, fireman and two brakemen were killed.

The wrecking of a freight train on the Lake Shore & Michigan Southern Ry., near Toledo, Dec. 4, blocked the tracks for seven hours. The accident was caused by a broken rail. The locomotive and several cars were derailed and overturned, blocking both tracks. The interruption to traffic was prolonged by the failure of a cable of the wrecking crane while it was lifting the locomotive. The "20th Century Limited" of the New York Central Lines, eastbound, was delayed six hours.

A passenger car on the Worcester Consolidated Street Ry. Co.'s line from Worcester to Clinton, Mass., ran at high speed through an open switch north of Worcester, Dec. 5, and crashed into a gravel car on the siding. Eight persons were seriously injured. It is stated that the motorman had been warned that the gravel train was at work at the point where the accident occurred and that he had been told to run slowly past the gravel bank spur.

A TYPHOID OUTBREAK AT READING, PA., had resulted in 552 reported cases up to Saturday night, Dec. 5. The beginning of the outbreak is given as Nov. 18. Mr. F. Herbert Snow, M. Am. Soc. C. E., Chief Engineer of the State Department of Health, and Dr. A. B. Moulton, Chief Medical Inspector, with a large staff of assistants, have been aiding in the endeavors to suppress the outbreak. Dr. Samuel G. Dixon, State Commissioner of Health, is reported as having concluded that the outbreak is not due to the milk supply. From the somewhat scanty information now at hand it appears that this is another example of infection of an unfiltered surface water supply by the dejecta from a typhoid case in the drainage of a portion of the city water supply. It is stated that portions of the city which enjoy a filtered water supply are relatively free from typhoid.

THE FREIGHT-CAR SITUATION remained stationary during the two weeks ending Nov. 25, 1908. The car surplus as reported increased by 12,000 (from 121,174 to 132,829), and the countervailing shortages decreased from 11,659 to 9,210; on the other hand, the number of cars in shop decreased by 10,000, which accounts for the larger part of the increased surplus and shows that the number of cars actually employed has remained about the same.

A LEGAL DECISION ON FERRY SERVICE rendered in New York on Dec. 3 establishes a certain obligation to continue a long-established public-service enterprise, but places this obligation on the public authorities, who own the leasehold, and not on the operating company. The New York Terminal Co. has been planning to discontinue operating five ferry lines across the East River between Manhattan and Brooklyn boroughs in New York City. Suit for an injunction to prevent discontinuance was begun by certain taxpayers against the company and the city as owner of the terminals. Justice Blackmar of the Supreme Court decided that the company cannot be compelled to continue a losing service, but that the city may be ordered to continue the service by leasing the ferries at public auction; a writ of mandamus to this effect was directed to issue. The lines in question have suffered a great loss of traffic as the traffic facilities of bridges and tunnels across the East River have increased. A special feature of the case is that the franchise for the five ferry lines belongs to the city in perpetuity, under a very old charter.

THE U. S. CRUISER "YANKEE," which was stranded on Spindle Rock, Buzzards Bay, ten weeks ago, as noted in our issue of Oct. 1, was floated and removed from the rocks on the afternoon of Dec. 4 at four o'clock and sank twelve hours later in Buzzards Bay, near Penikese Island. She is in comparatively shallow water and it is expected that comparatively little difficulty will be encountered in raising her. After the Government engineers had failed in repeated efforts to remove the "Yankee" from Spindle Rock, Mr. John G. Arbuckle, of Brooklyn, N. Y., was awarded a contract to float her by means of compressed air pumped into her hold. It was found possible to expel the water by this means and, after repairs had been made to the damaged hull, the vessel was successfully pulled from the reef by means of steam winches acting on long cables attached to heavy anchors. While the cruiser was being towed to New Bedford, Mass., the hawsers parted several times, due to the heavy sea prevailing, and, after one of these accidents, she was accidentally rammed by one of the tugs during the effort to put in place a new tow line. The compartment struck was that in which the air compressors were working which kept the vessel afloat, and it was found impossible to keep her from sinking.

PANAMA CANAL EXCAVATION during November totaled 2,920,494 cu. yds., a daily average of 126,978 cu. yds. for 23 working days, as against 3,282,276 cu. yds., a daily average of 121,565 cu. yds. for the 27 working days of October. The record for the past two months is as follows:

Steam Shovels.	November.	October.
Atlantic division	130,710	155,142
Central division	1,321,692	1,551,409
Pacific division	115,553	135,876
Dredging:		
Atlantic division	570,832	505,260
Pacific division	711,479	765,876
Canal prism total	2,850,266	3,113,563
Accessory works outside canal prism:		
By steam shovel	70,228	111,075
By dredgings	....	57,638
Total excavation	2,920,494	3,282,276

The rainfall during November was 11.66 ins. against 10.51 ins. in October.

A CONTRACTORS' SUIT AGAINST A RAILWAY company was decided in Newburgh, N. Y., on Nov. 25. The suit was brought by John F. Dolan & Co., of Elizabeth, N. J., against the Delaware & Eastern R. R. Co., the claim being that the engineers of the railroad company had omitted from their final estimate large quantities of work which had been performed by the contractors, and had not properly classified the material excavated, much material being classified as earth which the contractors had to blast. The suit was tried before a referee, Hon. A. H. F. Seeger, and judgment was rendered against the railroad company for $87,950.

A POWER-HOUSE CORNER STONE.—The unique ceremony of the laying of the corner stone of an industrial building by a Masonic lodge took place at Plant City, Florida, Nov. 28. The building was the power-house of the Coronet Phosphate Co., three miles southeast of Plant City. This building will house a 2,500-KW. steam turbine plant. The power-house is a part of a complete phosphate mining plant designed by Mr. C. G. Memminger, M. Am. Inst. M. E.

FOREST FIRE LOSSES IN NEW YORK STATE during 1908 are placed at nearly $800,000 by State Forest Commissioner Whipple. The property loss is given as $644,000 and the cost of fire fighting as $138,000. Of 700 fires reported 90 are attributed to hunters, and nearly 400 to railway locomotives, but of the latter only 86 became serious before they were extinguished. The total area burned over is given in acres as 177,476, of which 147,000 were previously burned areas, and 50,488 were state lands.

THE COST OF TREATING SEWAGE AT MANCHESTER, ENGLAND, has increased from about 12 cts. to about 23 cts. per capita during the five years beginning with 1903-4 and ending with 1907-8. This increase appears to be largely due to renewals of contact bed material during the past two or three years. Thus, in 1907-8 the maintenance cost of filtration was £3,474 and the renewal cost £10,072. These figures apply to the Davyhulme works, where the sewage is located by sedimentation, septic tanks and contact beds. The foregoing figures are taken from the annual report for 1907-8 of Mr. John Frowde, Chairman of the Rivers Department of the City of Manchester.

EXPANSION JOINTS IN A CONCRETE CONDUIT supplying the Spiez hydraulic generating station of the Vereinigte Kander & Hagneck Werke Co., of Berne, Switzerland, are constructed as follows: The conduit has rectangular section, 75 x 79 ins. inside, with 6-in. walls (reinforced); it crosses the valley of the Kander River on a stone arch viaduct. At intervals of 120 ft. is left a transverse expansion space of 6 ins. The ends of the abutting portions of the conduit are faced with 6-in. channels bolted back into the concrete. A band of 1/32-in. sheet copper encircles the expansion space. It laps inside the inner flanges of the edging channels, being fastened to them by cover plates bolted through the sheet to the channels. Between channel and copper, and between copper and cover plate, rubber sheet is interposed to make the joint perfectly tight. The copper band is sufficiently wider than the expansion space to bulge outward in semicircular shape, thus giving opportunity for several inches contraction of the conduit and at the same time being adapted to take up any expansion virtually up to 6 ins. This conduit carries water under a head varying from 2½ ft. to 5½ ft. It rests on a sheet of asphalted felt which rests on a gas-tar coating painted over the cement surfacing of the top of the bridge.

CAVING IN OF SURFACE LANDS in the anthracite coal regions is attracting general attention. Hon. J. Benjamin Dimmick, Mayor of Scranton, invited the authorities of cities and towns in the anthracite region to meet on Dec. 2 and consider measures to secure legislation for the protection of surface property owners from damages due to the caving in of mines.

A SUIT TO PREVENT THE BUILDING OF A SEWage disposal plant is to be brought by the Borough of Sharon, Pa. The State Board of Health of Pennsylvania recently ordered the boroughs of Sharon, South Sharon and Sharpsville to build a sewage-disposal plant to prevent the further pollution of the Chenango River. The borough officials claim, however, that Sharon has almost reached the limit of its borrowing capacity fixed by law, and hence is financially unable to build such a plant. It therefore brings suit to have the decree set aside.

DAMAGES FOR LOSS IN THE SAN FRANCISCO CONFLAGRATION are claimed by 100 property owners from the Spring Valley Water Co., owner of the San Francisco water-works. The complaints in the suit were filed in the federal courts of San Francisco on Nov. 17. The ground for the damages is the claim that the water company failed to locate its water mains in proper territory and upon solid bedding and foundation. It is stated that this is only the first of a series of suits which is to be brought, and that nearly 4,000 property owners have joined their claims in these actions.

PROGRESSIVE IMPROVEMENT OF SIGNAL PERformance has been so marked in the automatic signal equipment of the Baltimore & Ohio R. R. in the last seven years that the number of correct signal movements per signal failure is now eight times as great as in 1901. It is believed that more careful maintenance supervision of signals has been the chief factor in bringing about this improvement. The following table gives the figures recorded by the railway company:

Year.	No. of signals.	Perfect signal movements.	Failures.*	Correct movements per failure.	Failure, per cent.
1901	115	686,187	434	1,581	0.32
1902	337	4,795,318	1,075	4,460	.11
1903	308	5,604,875	1,154	4,856	.10
1904	239	6,170,208	1,014	6,085	.09
1905	247	7,237,797	682	10,612	.08
1906	308	9,011,758	651	13,843	.04
1907	388	10,857,912	598	17,852	.04
1908†	478	5,983,619	281	21,294	.02

*In computing failures, each regular train improperly stopped by a signal was counted as one; i. e., if a signal remained deranged long enough to stop four trains it counted as four failures.
†Six months of the year 1908.

As explained by the note below the table, the recorded failures are more than the number of separate derangements of signals. If the latter alone were recorded, the percentages of failure would be very much lower. As greater promptness in restoring deranged signals would improve the record, even without a decrease in the number of derangements, the table is primarily an exhibit of improved attendance rather than of lowered susceptibility of signals to derangement. However, the latter factor doubtless is concerned equally with the other in producing the reduction of failure from 0.32% to 0.04% in seven years.

ANOTHER SKEW BASCULE BRIDGE is to be built in the canal system of New York State [the North Salina St. bridge over the Oswego Canal at Syracuse was described in our issue of Sept. 24, 1908]. The Lyell Ave. bridge over the Erie Canal in Rochester, with a span of 45 ft. at right angles to the canal axis, will be located on a skew of 30°. It is to have a 38-ft. roadway and two 8-ft. sidewalks, and will cost about $30,000. It will be of the trunnion style; plans for it have recently been completed by the State Engineer's office. Designs have also been made for another trunnion bascule over the Erie Canal in Rochester, a square crossing of 48 ft. span on Allen St.

PENNSYLVANIA HIGHWAYS aggregate 99,041 miles of which 1,101 miles are privately owned toll roads. This is an average of 2.19 miles of road per square mile of area in the whole state. On Dec. 31 last there were 220 miles of road under contract, and bids had been received for about 80 miles more. In the year 1907 the state contributed $125,000 toward road maintenance, which was expended on 1,058 miles of road. The above figures are from the report of Mr. Jos. W. Hunter, the State Highway Commissioner.

PERSONALS.

Mr. W. W. Andrews, Borough Engineer of Carnegie, Pa., has been succeeded by the firm of Trimble & Miller, of Pittsburg, Pa.

Mr. Manual Parra has become Division Master Mechanic of the Mexican Ry. at Apizaco, succeeding Mr. J. B. Cozart, whose resignation was noted in our last issue.

Mr. T. L. Lewis, President of the United Mine Workers, has been appointed an ex-officio member of the national advisory board having general supervision over mine explosion investigations.

Mr. O. G. Gano, Civil Engineer in charge of the Newcastle, Pa., city survey and engaged in making the city maps, has resigned to become Chief Engineer and General Superintendent of the Shenango Limestone Co.

Mr. William K. Hatt, Assoc. M. Am. Soc. C. E., Professor of Civil Engineering at Purdue University, has been appointed a member of the U. S. Advisory Board of Fuels and Structural Materials.

Mr. F. H. Yost, for several years Football Coach of the University of Michigan, at Ann Arbor, has become General Manager of the Great Falls River & Power Co., of Chattanooga, Tenn., succeeding Mr. C. H. Fiske, deceased.

Mr. J. K. Russell, Superintendent of Motive Power of the Pennsylvania R. R., at Pittsburg, Pa., retired Dec. 1. Mr. Russell has served the Pennsylvania R. R. for 51 years and is to receive a pension. Upon retiring, he was presented by the officials of the company with a handsome "grandfather's" clock, and the engineers and firemen gave him a silver service.

Mr. Ellis Soper, Assoc. M. Am. Soc. C. E., Vice-President of the Hunt Engineering Co., Iola, Kan., and Superintendent of the Dixie Portland Cement Co., South Pittsburg, Tenn., has resigned both those positions to become President of the Soper Co., which has been organized for the purpose of dealing in all standard cement machinery and doing general cement engineering work. Mr. Soper's headquarters will be at 1110-11 Ford Bldg., Detroit, Mich.

A number of changes have been made in the officials of the Canadian Pacific Ry.: Mr. George S. Cantlie, Montreal, Que., has been appointed General Superintendent of Car Service, with jurisdiction over all divisions. Mr. Allan Purvis, Superintendent at Souris, Man., has been transferred to Nelson, B. C. Mr. D. C. Coleman, Superintendent at Nelson, B. C., has been transferred to Winnipeg, Man. Mr. James H. MacGregor, Assistant Superintendent of Car Service at Winnipeg, has resigned.

Mr. W. D. Elam (and not Mr. W. E. Elam, Jun. Am. Soc. C. E., of Greenville, Miss., as erroneously reported in this column Oct. 1) has resigned as Chief Engineer of the Board of Commissioners of the Orleans Levee District and is now engaged in private practice as a civil engineer and surveyor with office at 127 Carondelet St., New Orleans, La. Mr. Sidney F. Lewis, M. Am. Soc. C. E., was elected Sept. 17, 1908, to succeed Mr. W. D. Elam and had previously been connected with the State Engineer Department of Louisiana since 1877.

Mr. James B. French, Mem. Am. Soc. C. E., and Mr. Charles G. French, Landscape Architect, have opened an office in the Hudson Terminal Building, 30 Church St., New York. Mr. James B. French was formerly connected with the Long Island Railroad Co. as Bridge Engineer for the Atlantic Avenue Improvement, the Bay Ridge Improvement and for all of the company's lines on Long Island. Mr. Charles G. French graduated from Cornell University in 1891 and has practiced as a landscape architect since 1894.

Mr. Edward Lowrey Woodruff, M. Am. Soc. C. E., has resigned his position as Assistant Engineer of the Ninth Light-House District and contemplates entering into practice as a consulting engineer and architect in Los Angeles, Cal. Mr. Woodruff has been associated with the U. S. Light-House Establishment for several years and designed many light-house structures, notably the Racine Reef light near Racine, Wis., and the light-house now in course of construction on White Shoal near the Straits of Mackinac, Lake Michigan. He also designed the U. S. Light-House Tender "Hyacinth," which is now in use on the Great Lakes.

Obituary.

Edwin H. Jones, President of the Vulcan Iron Works, of Wilkes-Barre, Pa., died Dec. 2 at his home in that city at the age of 64 years.

E. L. Du Barry, for eight years Superintendent of Terminals of the Norfolk & Western Ry., at Norfolk, Va., died Dec. 4 from apoplexy. He was 68 years old.

James W. Leahy, County Engineer of Hudson County, N. J., died Dec. 5 at his home in Jersey City from heart failure. Mr. Leahy was born in Philadelphia, Pa., in 1860.

Gustav W. Garvens, Assistant Engineer in the Irrigation Division of the Bureau of Public Works, Manila, P. I., died in Manila of Asiatic cholera on Sept. 9, 1908. Mr. Garvens was formerly employed in irrigation work in the Indian service of the United States and entered the Philippine service in April, 1908.

D. D. Waldo, Resident Engineer of the New York State Department of Highways, at Albion, N. Y., died at Albion, Nov. 30, after a short illness. Mr. Waldo was Engineer in charge of the construction of the Goat Island bridge at Niagara Falls and took part in the harbor construction of the Erie Canal at Buffalo, N. Y.

Edward F. C. Young, President of the Joseph Dixon Crucible Co., and formerly President of the Consolidated Traction Co., of Jersey City, N. J., died Dec. 6 at his home in that city from cancer. Mr. Young was born on a farm near Morristown, Morris Co., N. J., in 1835 and was educated in the public schools of Jersey City. His first work was as a bank clerk and he eventually became President of the First National Bank of Jersey City. He was a director of several railway, insurance, trust and gas companies.

William M. Aiken, Consulting Architect of the Borough of Manhattan, New York City, from 1901-03, died at the New York Hospital Dec. 7, after an illness lasting ten days. Mr. Aiken was born at Charleston, S. C., in 1855 and received his education at the University of the South, Sewanee, Tenn. He afterward (1877-9) took up a special course in architecture at the Massachusetts Institute of Technology. He spent several years in teaching: Charleston High School, 1874-6, Cincinnati Art Academy, 1894-5, and Columbia University, 1899. He began independent practice as an architect in Cincinnati, Ohio, in 1886 and in 1895 became Supervising Architect of the U. S. Treasury Department, remaining in this position for two years. During this period he designed Government exposition buildings at Atlanta, Nashville and Omaha, mint buildings at Philadelphia and Denver and numerous postoffice and custom-house buildings. From 1897 to 1901 he was engaged in practice in New York City. Mr. Aiken was a Fellow of the American Institute of Architects and a member of several other architectural societies, and was a collaborator with Mr. Russell Sturgis in the preparation of the "Dictionary of Architecture."

ENGINEERING SOCIETIES.

COMING MEETINGS.

AMERICAN INSTITUTE OF ARCHITECTS.
Dec. 15-17. Annual convention at Washington, D. C. Secy., Glenn Brown, "The Octagon," Washington, D. C.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.
Dec. 28-29. Annual meeting at Pittsburg, Pa. Secy., John C. Olsen, Polytechnic Institute, Brooklyn, N. Y.

NATIONAL ASSOCIATION OF CEMENT USERS.
Jan. 11-16. Annual convention at Cleveland, Ohio. Secy., Geo. C. Wright, Harrison Bldg., Philadelphia, Pa.

IOWA ENGINERING SOCIETY.
Jan. 13-14. Annual convention at Waterloo, Iowa. Secy., A. H. Ford, Iowa City, Iowa.

MICHIGAN ENGINEERING SOCIETY.
Jan. 12-15. Annual convention at Ann Arbor, Mich. Secy., Alba L. Holmes, 574 Wealthy Ave., Grand Rapids, Mich.

INDIANA ENGINEERING SOCIETY.
Jan. 14-16. Annual convention at Indianapolis, Ind. Secy., Charles Brossman, Union Trust Bldg., Indianapolis, Ind.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.
Jan. 19. Annual meeting at New York City. Secy., W. M. Mackay, P. O. Box 1818, New York City.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
Jan. 20. Annual meeting at New York City. Secy., Charles W. Hunt, 220 West 57th St., New York City.

OHIO ENGINEERING SOCIETY.
Jan. 26-28. Annual convention at Columbus, Ohio. Secy., Paul Hansen, Harrison Bldg., Columbus, Ohio.

ILLINOIS SOCIETY OF ENGINEERS AND SURVEYORS.
Jan. 27-29. Annual meeting at Chicago, Ill. Secy., E. E. R. Tratman, 1636 Monadnock Block, Chicago.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
Jan. 28. Annual meeting at Toronto. Secy., C. H. McLeod, 413 Dorchester St., W., Montreal, P. Q.

ENGINEERS' CLUB OF BALTIMORE.—At the meeting held Dec. 5, Major Joseph W. Shirley, Chief Engineer of the Topographical Survey Commission of Baltimore presented a paper entitled "Topographical Surveys."

THE SWEDISH ENGINEERS' SOCIETY OF CHICAGO.—Meetings are held on the first Saturday of each month. The society has been recently formed with the intention of effecting a closer relationship among the Swedish engineers throughout the United States. The secretary is Mr. G. A. Akerlind, 303 Wabash Ave., Chicago, Ill.

THE STEVENS ENGINEERING SOCIETY.—This society has become affiliated with the American Society of Mechanical Engineers as the first Student Section. At the meeting held at the Stevens Institute of Technology, Dec. 3, a lecture on "Skyscrapers and the Singer Building" was delivered by Mr. Chas. G. Armstrong, of New York City.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—At the meeting of the Mechanical Section Dec. 3, Mr. Kenneth Moodie presented a paper on "Force or Pressure Fits for Armature or Fly-Wheel Hubs." This paper discusses the practice of the Westinghouse, Western Electric and General Electric companies, and includes tables showing hub thicknesses, diametral allowances and pressures for different shaft diameters. A meeting of the Mining Section will be held in Montreal, Dec. 17.

BROOKLYN ENGINEERS' CLUB.—The annual meeting is to be held at the Brooklyn German Club House Dec. 10. The following list of nominations has been presented: President, James C. Meem; Vice-President, Winfred H. Roberts; Secretary, Joseph S[illegible]; Treasurer, William T. Donnelly; Directors, James W. Nelson and Chas. M. Spofford. At the annual meeting, which will immediately precede the meeting, additions will be made by William T. Sedgwick, Andrew M[illegible], Alfred T. White and Richard C. Maclaurin.

INDIANA ELECTRIC LIGHT ASSOCIATION.—The inaugural meeting was held in Indianapolis, Ind., Nov. 26. The membership is made up of owners, managers, superintendents and others interested in electric light plants and it is the purpose of the Association to establish a closer relationship between the members and to facilitate the exchange of ideas and experiences in methods of operation. Mr. Thomas McReynolds of Kokomo, Ind., was elected to the presidency and the Secretary is Mr. Fred Leslie, Muncie, Ind.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION.—The Board of Directors has appointed a standing committee on electricity to consider subjects in connection with the electrified sections of steam railways. The scope of its work is stated to cover electric traction and transmission as affecting the design, construction, maintenance and operation of railways. Mr. Geo. W. Kittredge (Chief Engineer of the New York Central) is Chairman, and Mr. J. B. Austin, Jr. (Long Island), is Vice-Chairman. The other members of the committee are as follows: F. A. Bagg (T. & G.), R. D. Coombs (Pa. Tun. & Term.), W. W. Drinker (Erie), E. P. Dawley (N. Y., N. H. & H.), G. A. Harwood (N. Y. Central), C. E. Lindsay (N. Y. Central), H. R. Talcott (B. & O.).

AMERICAN MINING CONGRESS.—Among the papers presented at the eleventh annual session at Pittsburg, Pa., Dec. 2-5, were the following: "Report of Committee on Prevention of Mine Accidents," H. Foster Bain, Urbana, Ill.; "Report of Committee on Investigation of the National Forest Service and Its Effects Upon the Mining Industry," A. G. Brownlee, Denver, Colo.; "Conservation in the Coal Industry; Protection of Life and Prevention of Waste," John Mitchell, Indianapolis, Ind., G. W. Traer, Chicago, Ill., J. B. Zerbe, Cleveland, Ohio, J. V. Thompson, Uniontown, Pa.; "Formal Opening of the Government Stations for Investigation of Mine Explosions," James R. Garfield, Washington, D. C., O. W. Underwood, Birmingham, Ala.; "The New Mining Industry: The Rare Metals," Herman Fleck, Colorado School of Mines; "Secondary Mining Education," H. H. Stock, Scranton, Pa.

The attention of the congress was particularly directed to the question of the prevention of accidents. On Dec. 3 the Government laboratory and testing station recently established at Pittsburg was formally opened and a series of tests were performed in the presence of the members. These tests related chiefly to dust explosions and "safety" explosives, and in connection with the tests was given an exhibition of the utility of the Draeger oxygen apparatus. A resolution was introduced recommending the provision of a tax of ½ ct. per ton on all coal mined to provide for pensions and relief in case of mine accidents.

WESTERN SOCIETY OF ENGINEERS.—At the meeting held at the Society's rooms in Chicago on Dec. 2, Mr. H. H. Evans presented a paper on "The Electrification of Railway Terminals," relating particularly to the present public movement towards inducing the Illinois Central Ry. to introduce electric traction on its lines in Chicago. The paper opened with a discussion on the general advantages and economics of electric traction, and with some remarks on the improvement of terminal facilities.

The author then gave particulars of numerous electric railways in this country and abroad, but several of these have no particular relation to terminal traffic. Thus the London underground railways and other rapid transit lines were mentioned although nothing was said about the electric elevated and underground rapid transit lines of American cities. The New York terminals of the New York Central Ry. and the New York, New Haven & Hartford Ry. were mentioned, together with the St. Clair tunnel and some interurban lines.

The Illinois Central Ry. terminal station is used by four other roads and has about 100 trains per day, including freight trains. There is also a suburban terminal at Randolph St., with about 260 trains per day. The total mileage, which it is considered should be equipped for electric traction is about 325 miles of track. This would include not only the suburban service, but also main line passenger and freight service, and all yard and switching work within the city.

CONSTRUCTION NEWS

Supplement to ENGINEERING NEWS. New York, December 10, 1908.

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CONSTRUCTION NEWS.

PLANS AND SPECIFICATIONS ON FILE.

(denotes that this work is advertised in Engineering News.)*

The following plans (P.) and Specifications (S.) are on file and may be seen at the office of The Engineering News Publishing Co., 220 Broadway, New York.

Bids close.	Work.	Place.	See Issue.
12-12*	Pile pier,	Mich. City, Ind.	(S.)11-12
12-14*	Bridge,	Green Bay, Wis.	(P. & S.)11-19
12-14*	Steel tank and tower,	Gridley, Cal	(S.)11-19
12-24*	Seawall,	Fort Morgan, Ala.	(P. & S.)12- 3

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1- 4*Engines, generators, etc., Ft. Monroe, Va 12-10

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12-14 Quarters, Ft. Geble, R. I.....12- 3
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12-21 Ice machine, etc., Burrwood, La. (Mfg. Pl.) 12- 3
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12-12 Paving, Purcell, Okla.....12- 3
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12-12 Fences, gates, Ft. Sam Houston, Tex. 12- 3
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1- 6 Inspector of Boilers, Wash., D. C.12-10
1- 6 Asst. Engr., Wash., D. C.....12-10
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RAILWAYS.

ALBERTA CENTRAL.—This company is applying to the Dominion Government for an extension of time and also power to increase its capital from $1,000,000 to $2,000,000, and its bond issue from $20,000 to $35,000 per mile. Permission for extensions to its plans are also sought. Noted on Oct. 22.

CANADIAN NORTHERN.—The company has ordered 1,000 box cars which, with passenger equipment, will aggregate $1,000,000, from the RHODES-CURRY CAR CO., Halifax, N. S.

CHICAGO, ROCK ISLAND & GULF.—Surveys are now under way, it is announced, for the proposed extension from Graham, Tex., southwest to Haskell, about 75 miles.

CHICAGO, ROCK ISLAND & PACIFIC.—Contract has been awarded to the UNION SWITCH & SIGNAL CO., Pittsburg, Pa., for equipping 1,250 miles of the Rock Island System with signals. The order was awarded in two installments. The first one called for the equipment of 750 miles on the St. Louis & San Francisco road, which belongs to the Rock Island system, and 500 miles on the Rock Island proper. This work represents, it is said, the largest contract for automatic block signaling which has ever been placed by a railroad company, with the exception of the order which the Union Swith & Signal Co. received some two years ago from the Harriman lines.

CLINTON & OKLAHOMA WESTERN.—This company, which was recently chartered, proposes to build from Clinton, Okla., northwest and southeast for a distance of about 200 miles in each direction. It will reach Lehigh, Okla., or some other point in the coal fields southeast, and Trinidad, Colo., northwest. Active construction probably will begin about Jan. 1. J. H. O'Hearn is Engr.-in-Charge, at Clinton, Okla. The directors of the company are C. C. Godman, T. J. Nance, E. A. Humphrey, C. H. Lamb and J. T. Bradford, of Clinton. Fully noted on Nov. 19.

COLORADO, TEXAS & MEXICO.—Construction will be resumed on this line about Jan. 1. Seventy-nine miles are graded and some material is on the ground. The COLORADO CONSTRUCTION CO., Mangum, Okla., is the contractor. This line is to run from Mangum, Okla., southwest to Comfort, Tex., about 510 miles. Noted officially on July 30.

COLORADO & SOUTHERN.—In 1888 a railway which was in operation between Fort Collins, Colo., and Cheyenne, Wyo., was torn up because it was decided that there was no necessity for it. "The Colorado & Southern Ry. Co.," according to the Denver "Post," "will send a corps of civil engineers to make final surveys for the re-establishment of the line which was destroyed 20 years ago. The proposed line, when completed, will give the Colorado & Southern a direct railway from Denver to Orin Junction, Wyo. It now has a line from Cheyenne to Orin Junction, also a line from Denver to Wellington, north of Fort Collins. The proposed extension will cost approximately $1,000,000. It will mean the building of 35 to 40 miles of railway. It will open up an agricultural region."

CRAGS & CANON RY.—Incorporated in Colorado to build a standard-gage railway from Crags (Rollinsville post-office), on the Denver, Northwestern & Pacific Ry., to Eldorado Springs, thence to Boulder. The final survey from Crags to Eldorado Springs, with a maximum grade of 4%, has been established, it is said, and the line from Eldorado Springs to Boulder will not exceed a maximum of 1%. The line finally determined upon starts from Crags station, winding around Crags Mountain by way of Crags resort, down the Quarz Creek and South Boulder canyons to Eldorado Springs. Capital stock, $300,000. Incorporators: George F. Keller, Fort Wayne, Ind.; L. B. Bradley, Chicago; G. A. Brink, D. C. Nevin and N. S. Williams, of Denver.

CROWS NEST & NORTHERN.—Surveys have been filed by this company with the British Columbia Government for a line to be built from Crows Nest, B. C., twelve miles. J. A. Williams, Pres., and C. O. Diffenderfer, Ch. Engr., Spokane, Wash.

DAKOTA, KANSAS & GULF.—This company, incorporated in Kansas with a capital stock of $3,000,000, to build a line from Beloit, Kan., on the Missouri Pacific, northwest to Kearney, Neb., on the main line of the Union Pacific Ry., 110 miles, is stated to have awarded contract for construction work to the INTERURBAN CONSTRUCTION CO., New York, of which Leslie M. Shaw, 115 Broadway, New York, is Pres. The incorporators include: F. T. Lock, New York; C. E. Gardner and F. P. Larmon, both of Troy, N. Y.; C. W. Kibler and J. M. Patterson, both of Kearney, Neb., and W. H. Mitchell, of Beloit, Kan.

EAST RIVER TERMINAL R. R.—The Public Service Commission has granted the application of the East River Terminal R. R. Co. for a certificate of public convenience and necessity as to the crossing of Kent and Wythe Aves., Brooklyn, N. Y., between North Third and Fourth Sts., with six tracks. A franchise conferring this right will have to be obtained from the Board of Estimate and Apportionment. This action by the commission marks the first step toward the building of a huge freight terminal, said to be perhaps the largest in the country, according to the New York "Tribune." If the actual franchise can be obtained from the Board of Estimate it is understood the company is ready to begin work at once. The plan is to build a 12-story terminal warehouse on the block between Kent and Wythe Aves. and Third and Fourth Sts. in conjunction with the terminal on the adjoining block on the East River front. These plans contemplate the expenditure of at least $4,000,000, and this terminal warehouse is to be only a beginning, as the company hopes to extend beyond Wythe Ave.

GREAT NORTHERN.—The survey for a line from the United States boundary to Winnipeg, Man., has been completed. It follows the original right-of-way secured in the early days of the history of the province. The construction of the line will begin in the spring. The line runs from Emerson, on the east side of Red River, to St. Agathe, where it crosses to the west side of the river and runs in a northwesterly direction to the terminal property on Rosa Ave., purchased a couple of years ago in this city, and running parallel with the Canadian Pacific Railway's Gretna branch.

IDAHO & WASHINGTON NORTHERN.—The contract for grading an extension from Newport to Ione, Wash., has been awarded to GRANT SMITH & CO., Newport, Wash. Noted on Oct. 29.

IOWA & OMAHA SHORT LINE.—Geo. W. Adams, Pres., Wainut, Iowa, advises us that construction work will begin next spring. Contracts have not been let yet. The line will extend from Omaha, Neb., to Des Moines, Iowa, 134 miles. Surveys are made and right-of-way secured. Fully noted on Oct. 29. Ernest E. Cook is Ch. Engr., Council Bluffs, Iowa.

KINGSTON RY.—Eight miles of this line are now completed from Kingston, La., on the Kansas City Southern Railroad, eastward through timber lands, and the company is building five miles further to probably connect at Westdale with the Texas & Pacific Railway. J. A. Smith, of Kingston, has charge of construction. W. R. Bradford is Pres.; T. E. Smith is Vice-Pres., and R. E. Comegys is Secy. and Treas., at Kingston, La. Noted on Nov. 19.

MISSOURI SOUTHERN.—Company may build an extension from Bunker, Mo., northwest to Salem, 28 miles. G. W. Payne is Ch. Engr., Leeper, Mo. Company operates 44 miles of railroad from Leeper to Reynolds with 20 additional miles of branches.

PENNSYLVANIA R. R.—Estimates for $5,000,000 worth of work along the main line of the Pennsylvania Railroad have been asked, it is said. The contract to be let will include the damming of the Juniata River, cutting away part of the mountain to eliminate a big curve and grade and the erection of a power plant near Lewistown. Alex. C. Shand, Philadelphia, is Ch. Engr.

RICHMOND, URBANNA & PENINSULAR.—We are officially informed that contracts probably will be let within the next month for building this line. The line will run from West Point, Va., to Centerville, Saluda and Urbanna, 16.8 miles. Surveys are made and right-of-way is obtained. Capital is now being secured. J. C. Robertson is Pres., Merchants' Bank Bldg., Richmond, Va.; C. P. E. Burgwyn is Ch. Engr., 917 Bank St., Richmond; Boyce D. Brooker is Vice-Pres., 1013 West Franklin St., Richmond. Noted fully on Nov. 12, under Electric Railways—Richmond, Va.

SAVANNAH VALLEY.—This railroad, as projected, will run from Garnett (now Millhaven) to Sylvania and Egypt, Ga., about 35 miles. Officers: E. T. Comer, Pres., Millhaven, Ga.; J. H. Perkins, Vice-Pres., Sylvania, Ga.; H. R. Perkins, Secy., Augusta, Ga.; John E. Fay, Mgr., Egypt, Ga.; W. J. Walker, Treas., Sylvania, Ga. P. E. Jenkins is Engr.-in-Charge, Sylvania. J. W. WRIGHT, Jr., is the contractor, as noted on Oct. 29.

SHEARWOOD R. R.—J. N. Shearouse, Pres. of the Shearwood Lumber Co., Shearwood, Ga., states that this company is building a railroad from Brookiet to Groveland, 17 miles, which will be known as the Shearwood Railroad. It will be extended as the needs of the lumber company require.

UNITAH R. R.—This company, which now operates 55 miles of railway from Mack, Colo,. northwest to Dragon, Utah, has made surveys for an extension from Dragon northwest to Randlett, 65 miles. M. W. Cooley is Gen. Mgr., Mack, Colo.

WESTERN TRANSPORTATION CO.—See under Electric Railways—Portage, Wis.

VALDOSTA, MOULTRIE & WESTERN.—Application has been made by this company for a charter to build a line from Caldosta to Moultrie, Ga. Capital stock, $100,000. Incorporators: Frank Roberts, W. B. Conoley, John T. Roberts, W. L. Roberts, A. L. Davis, W. E. Davis, A. F. Langford, D. Ingram and J. L. Giddens, Valdosta, and W. P. Roberts, Jacksonville, Fla. The new road will be about 40 miles long and will run through the counties of Lowndes, Brooks and Colquitt.

ELECTRIC RAILWAYS.

RUTLAND, VT.—The organization of the Otter Creek Electric Ry. Co., which proposes to build an electric railway system, about 50 miles in length, connecting Rutland, Clarendon, Wallingford, Danby, Dorset, Manchester, Sunderland, Arlington and Shaftsbury, has not been fully completed. Capital stock will be $50,000. Noted on Nov. 12. H. B. Barden, Wallingford, Vt., is interested.

BRATTLEBORO, VT.—The Brattleboro & Vernon R. R. Co. has been incorporated in Vermont to construct an electric railway from Brattleboro through Vernon to the Massachusetts State line. Capital stock, $10,000. Incorporators: Charles R. Crosby, George L. Dunham, H. L. Emerson, J. H. Estey, Olin L. French, Lyman E. Holden, M. J. Moran, George W. Pierce, Howard C. Rice, L. D. Taylor, William H. Vinton, Henry P. Wellman, all of Brattleboro, Vt., and A. A. Dunklee, J. C. Allen, E. H. Akley, A. G. Barnes, John Wright, T. E. Stockwell, all of Vernon, Vt.

NEW YORK, N. Y.—Contract has been awarded to the BRADLEY-GAFFNEY-STEERS CO., 1 Madison Ave., New York, for the electrification of the New York, New Taven & Hartford R. R. Co.'s 6-track line

from New Rochelle to 129th St., thence by tunnel under the East River to Astoria and to Long Island City, with another East River tunnel and subway to the passenger station to be erected on the block bounded by Fourth and Lexington Aves., 32d and 33d Sts., New York. Estimated cost, $30,000,000.

CARLISLE, PA.—We are officially advised that the Cumberland Ry. Co. has let construction contract to W. F. PASCOE, of Carlisle, for building its proposed line. It will connect Carlisle and Newville, a distance of twelve miles. Right-of-way is not all obtained. Survey has been finished. W. E. Glatfelter is Pres.; J. A. Ring is Secy., and M. P. Moore is Ch. Engr., all of Carlisle. Noted on Oct. 22.

PENNSBURG, PA.—J. L. Bowles, of New York, it is stated, has made application to the Borough Council for a franchise for an electric railway. Similar applications have been made to the various town councils in the Perkiomen Valley through which the railway will pass.

WILMINGTON, DEL.—It is announced that the Columbia Power, Light & Railway Co. has been chartered in Delaware to act as a holding company for the Columbia & Montour Electric Ry., the Danville & Bloomsburg Street Ry., the United Gas & Electric Co., the Irondale Electric Light Co., the Standard Electric Light Co., the Standard Gas Co. and the Berwick Electric Light Co. These companies all operate in Columbia and Montour Counties. Capital stock, $1,200,000. Incorporators: W. H. Sponsler, New Bloomfield, Pa.; M. P. Reed, Philadelphia, Pa., and C. L. Ward, Wilmington, Del.

MORGANTOWN, W. VA.—H. R. Warfield, Pres. of the Deckers Creek & Cheat River Ry. Co., Morgantown, advises us that company will not let contracts for construction of the proposed line. Company will purchase electric current from local company. Survey has been made and capital secured. On Oct. 22 it was noted that this company "proposes to build an electric railway up Deckers Creek by way of Delislow to Cheat River. This part of the work is expected to begin at once. The road may be extended to Point Marion, Pa., where it will connect with an electric road to be built from Fairchance, Pa. J. H. McDermott and H. R. Warfield, of Morgantown, are interested."

BURLINGTON, N. C.—About Jan. 1 construction will begin on the electric railway to be built by the Burgrahaw Interurban Co. to connect Burlington, Graham and Haw River, eight miles long. Specifications will be ready about Dec. 15. The company is interested in quotations on material, supplies and equipment. J. W. Murray is Pres. and Junius H. Harden is Secy., at Burlington, N. C. Noted last week.

CHARLOTTE, N. C.—The Carolina Valley Ry. (steam) running from Thomasville to Denton, a distance of 21 miles, was sold at auction at High Point recently to B. L. Jones and W. T. Van Brunt, New York. The North Carolina Electric Co.'s charter and rights of way between High Point and Thomasville were sold to E. D. Steele and W. T. Van Brunt, New York. The purchasers announce that both projects will be completed.

GULFPORT, MISS.—We are officially informed that contracts probably will be let by the Gulfport & Mississippi Coast Traction Co. next month for constructing the proposed 6-mile extension from Long Beach to Pass Christian. Surveys are completed and capital ready. Right-of-way is not secured. J. T. Jones is Pres., and W. F. Gorenflo is Supt., Gulfport. This company now operates 25 miles of line. An electric light plant may be built.

FAIRBURN, GA.—The Fairburn & Atlanta Ry. & Elec. Co. is now running preliminary surveys. It is not yet ready to award any contracts. The road will be standard-gage, connecting Fairburn, Union City, Stonewall, Red Oak, College Park and Atlanta, and will be approximately twelve miles long. It has been decided to use the overhead trolley system. Capital stock, $100,000. Officers: W. T. Roberts, Fairburn, Pres.; W. A. McCurry, Fairburn, Vice-Pres.; J. H. Harris, Union City, Ga., Secy.; J. H. Langino, Fairburn, Treas.; Frank Lederle, 509 Candler Bldg., Atlanta, is Engr. Noted on Nov. 26.

GADSDEN, ALA.—The Alabama Power Co., which was incorporated for the purpose of developing the water-power of the Coosa River to generate electricity for lighting and other purposes, has filed plans and specifications with the Secretary of State.

PORTAGE, WIS.—We are advised officially that the Western Transportation Co. will let contracts soon for the construction of its proposed standard-gage railway. It will be operated by both steam and electricity and will extend from Portage to Briggsville, Oxford, Friendship and Grand Rapids, Wis., 75 miles. Capital is ready and surveys are made. Right-of-way is partly obtained. J. N. Braun, National Bank Bldg., St. Paul, is Pres.; C. Oehler is Ch. Engr., and A. B. Karns is Secy., both of St. Paul. Noted fully on Nov. 5.

EAU CLAIRE, WIS.—We are officially informed that the Benton Harbor-St. Joseph Ry. & Light Co. proposes to let contracts soon for building an extension from Eau Claire to Dowagiac, Mich., ten miles. Noted on Oct. 29. Right-of-way is partly obtained. Survey is made. C. K. Minary is Pres. and H. C. Mason is Gen. Mgr., Benton Harbor, Mich.

MILWAUKEE, WIS.—The Milwaukee Elec. Ry. & Light Co. is planning an extension of its Wauwatosa line from the county buildings to Elm Grove, Brookfield, Pewaukee, Lakeside, Hartland, Nagawicka, Nashotah, Okauchee, Gifford's and Oconomowoc. The line has been planned for some time. Survey has been completed and efforts are now being made to secure the franchise. John I. Beggs is Pres. and Gen. Mgr., Milwaukee.

SIOUX CITY, IOWA.—The City Councils of Spirit Lake, Hartley, Primghar, Paulina and LeMars along the route of the proposed Sioux City & Spirit Lake Interurban Elec. Ry., have voted to grant franchises granting right-of-way to the company for its railway line and electric light and power systems. The line will be 110 miles in length. Westinghouse, Church, Kerr & Co., 10 Bridge St., New York, are the contractors; Fred Davis is Secy.; L. F. Wakefield is Ch. Engr., Hartley. Noted on Oct. 22.

OMAHA, NEB.—W. D. Crist, Gen. Mgr. of the Nebraska Traction & Power Co., Omaha, advises us that this company has already let general contract for building its proposed line from Omaha to Papillion, Neb., seven miles, and that construction is nearly half completed. Surveys are made and capital and right-of-way are secured. Mel Uhl is Pres. and R. H. Oliver is Ch. Engr., both at Omaha. Noted on Oct. 15.

RUSSELLVILLE, ARK.—The Russellville Water & Light Co. has been organized to take over the franchise of the Russellville & Ozark Mountain Light & Transit Co., which was organized in June, 1907, with a capital stock of $200,000, for the purpose of constructing a light and water plant at Russellville and an interurban line between Russellville and Dover. The new company has been organized with a capital stock of $1,000,000, of which $51,000 has been paid in. Officers: A. Brewster, Pres.; C. S. Bacon, Vice-Pres.; Garland Brewster, Secy. and Treas. Offices of the company will be in Pine Bluff, Ark.

WACO, TEX.—The Citizens' Railway Co. will build an extension to East Waco over the Brazos River. W. S. Rathell is Supt.

TACOMA, WASH.—T. G. Seixas, Gen. Mgr. of the Pacific Traction Co., states that plans, specifications and engineering data for several new lines, for which franchises have already been granted by the council, have been prepared.

CENTRALIA, WASH.—W. H. Patterson and A. Welch, of Portland, Ore., and Theodore Moss, have applied to the City Council for an electric street railway franchise.

NORTH YAKIMA, WASH.—Frank E. Farquhar, of Tacoma, Wash., has applied to the City Councils of Roslyn and Cle Elum and the Commissioners of Kittitas County for a franchise for an electric road connecting those two towns and Lake Cle Elum. It is understood that eastern capital is behind the proposition and that construction work will be begun next spring.

WALLA WALLA, WASH.—The Farmers' Traction Co. was organized recently at a meeting of delegates from Dayton, Waitsburg, Prescott, Touchet, Wallula and Walla Walla at Walla Walla. Company is securing plans for the construction of a railroad from Dayton to the Columbia River. Dr. N. G. Blalock, Walla Walla, is Pres. and Gen. Mgr. The other officers are: First Vice-Pres., M. R. Hanger, Dayton; Second Vice-Pres., W. E. Cahill, Dayton; Third Vice-Pres., H. H. McLean, Pres. County Farmers' Union, Walla Walla; Secy., L. C. Davidson, Walla Walla; Treas., George E. Kellough. Plans were adopted to take over the old company organized two years ago, known as the Walla Walla-Columbia Traction Co., with right-of-way, franchises and other assets, and immediately begin work of grading the line, using the farmers' teams and right-of-way donated by the farmers. The proposed line will begin at Dayton, pass through Huntsville, Waitsburg, Prescott, Walla Walla, Touchet and Wallula, connecting there with boats on the Columbia River.

LIGHT AND POWER PLANTS.

(denotes that this work is advertised in Engineering News.)*

BANGOR, ME.—The Maine Central R. R. Co. is considering the question of changing the motive power of its Mount Desert Branch from steam to electricity, it is stated. It is proposed to equip the present branch from Bangor to Ellsworth, to be operated by electricity, and build a new road from Ellsworth to Bar Harbor. Electricity for operating the road would be furnished from the power plant of the Bar Harbor & Union River Power Co., located on the Union River, at Ellsworth. T. L. Dunn, Portland, Me., is Ch. Engr.

NEW YORK, N. Y.—Bids are asked until 3 p. m., Dec. 17, by the Park Board, Henry Smith, Pres., for all the labor and materials required for furnishing and installing electric work in the department shops and stables located on the 86th St. Transverse Road, in Central Park, Boro. of Manhattan.

The following bids were received on Dec. 2, by Robert W. Hebberd, Comr. Dept. of Public Charities, for all materials and labor required for the complete conduiting, electric wiring and all other work in connection with the installation of a complete electric lighting and power system for certain of the buildings and grounds under the jurisdiction of the Department of Public Charities, and included in the Metropolitan Hospital District, Blackwell's Island, Boro. of Manhattan: Cowden & DeYoung, 1123 Broadway, $14,300; E. J. Duggan, 1123 Broadway, $19,761; L. K Comstock & Co., 50 Church St., $21,600.

ALBANY, N. Y.—The State Lunacy Commission has awarded contracts as follows: To GRISCOM SPENCER CO., 90 West St., New York, for furnishing and installing boiler, heater, tank and piping at the Long Island State Hospital, in accordance with bid submitted Sept. 23, and to JOHN DYER, JR., of Albany, N. Y., the contract for conduits for the acute hospital, including steam piping and construction, at the Binghamton State Hospital, Binghamton, N. Y.

BERGEN, N. Y.—Plans for the construction of a municipal electric light plant for Bergen are being prepared by A. S. Crocker, Mechanics' Institute, Rochester, N. Y. Equipment of the plant has not been fully decided upon; two horizontal tubular boilers and two direct-connected, steam-engine driven generators will be installed.

BUFFALO, N. Y.—The committee on finance of the Board of Aldermen and Board of Supervisors have voted to install an electric lighting system in the city and county hall building, in accordance with plans prepared by J. J. O'Leary, 62 Niagara St., Buffalo, N. Y. The plans include the erection of 22 bronze standards supporting 500-c.-p. lamps. The cost of the work is estimated at $75,000, for which bids are now being received by the Board of Trustees of the City and County Hall.

BROADALBIN, N. Y.—The Public Service Commission has granted the Broadalbin Electric Light & Power Co. permission to issue $42,500 in capital stock and bonds to the amount of $10,000, the proceeds to be used to pay present obligations of the company, amounting to about $13,000, and the remainder for the construction of a dam, power house, equipment and transmission lines. Joseph B. Crane is Mgr.

*GOWANDA, N. Y.—The bids received by the State Commission in Lunacy on Dec. 2 for furnishing and installing engine and dynamo and underground electric feeder cables for power house, superintendent's residence and staff house at the Gowanda State Hospital, Gowanda, N. Y., were: (1) For engine and dynamo; (2) for underground feeder cables; (3) for entire work, including (1) and (2). The G. & W. Mfg. Co., 26 Cortlandt St., New York, (1) $4,953; (3) $8,273; 90 days. Fort Wayne Electric Works, Ft. Wayne, Ind., (1) $4,479; 90 days. Buffalo Electrical Contracting Co., Buffalo, N. Y. (1) $4,244; (2) $2,788; (3) $6,994; 60 days. Edward Joy, 133 Market St., Syracuse, N. Y., (1) $5,181; (2) $2,771; (3) $7,952; 90 days. John Kelly, Syracuse, N. Y., (1) $4,852; (2) $3,147; (3) $7,940; 60 days. Commercial Construction Co., (1) $4,142; (2) $2,260; (3) $6,143; 90 days. J. C. Stearns Co., Buffalo, N. Y., (1) $4,402; (2) $3,100; (3) $7,502. Frost & Sheldon, Albany, N. Y., (1) $3,950; (2) $2,100; (3) $5,850; 90 days. Rochester Electric Motor Co., Rochester, N. Y., (2) $2,951; 60 days. F. P. Little Electrical Co., Buffalo, N. Y., (1) $3,966; (2) $2,414; (3) $6,380. T. E. McGarr is Secy.

CLEARFIELD, PA.—It is reported that ground has been broken for the erection of a gas plant by the Clearfield Gas Co. on the company's ground between the P. R. R. and N. Y. C. R. R. near the N. Y. C. station. Cost, $25,000. J. B. Nevling is Pur. Agt. and Supt.

*FORT MONROE, VA.—Bids are asked by Capt. Ernest R. Tilton, Q. M., until 10 a. m., Jan. 4, for furnishing and installing two 264-HP. and one 100-HP. boilers, two 250-HP. compound engines, one 250-HP. and one 120-HP. engines, two 150-KW. and one 75-KW. generators; also all steam, exhaust steam, drip and water, suction and discharge connections; one service condenser and gage board, two boiler feed pumps, three composite inspirators, one feed-water heater, one hot well and automatic pump for oil separator. Also for furnishing and installing complete underground system and complete system street lighting at Fort Monroe, Va.

BLACKSBURG, S. C.—R. H. HARDAWAY, of Columbus, Ga., has been awarded the contract by the Southern Power Co., of Charlotte, N. C., to build a dam on the Broad River near Blacksburg, S. C., 1,100 ft. long and 90 ft. high. This dam, together with the building of a power house, will represent an expenditure of $1,000,000, it is stated. The dam is planned to develop 20,000 HP.

CHESTER, S. C.—Electrical equipment is to be installed in three cotton plants of this state which will furnish an aggregate of 4,000 HP. The Lancaster Cotton Mills, of Lancaster, will use 2,500 HP., while the Eureka Cotton Mills and the Springstein Mills of Chester will require 750 HP. each. They have equipments of 74,184 spindles and 1,578 looms for manufacturing sheeting and yarns; 14,748 spindles on yarns, and 14,112 spindles and 992 looms on ginghams, respectively. Leroy Springs, of Lancaster, is Pres. of each.

SPRINGFIELD, OHIO.—Bids for the construction of the power plant and laundry at the City Hospital have been received by the Trustees in the office of William Mahoney, City Clerk. John B. Linn submitted the only complete bid. He agrees to do all of the work, install the machinery and guarantee the plant for $14,000.

EVANSVILLE, IND.—The Evansville Gas & Light Co. has ordered plans for improving its plant, the construction of a gas holder, and the installation of machinery. Estimated cost, $500,000.

CHICAGO, ILL.—Arrangements are being made for the construction of a new plant for the Featherstone Foundry & Machine Co., Chicago, Ill., to be located at 59th St. and Cottage Grove Ave. The plant will be operated by electricity, which will be purchased.

CRIVITZ, WIS.—The Northern Hydro Co., of Green Bay, Wis., has perfected its plans for developing power at High Falls on the Peshtigo River about 15 miles from Crivitz. The actual work of construction is to start next spring. The plan of constructing a canal between High Falls and Johnson Falls has been abandoned. Instead the company will build a wall one mile long for the purpose of creating a reservoir. The wall will extend across the river at High Falls and back into the country until it reaches the high land. It will be of concrete. The estimated cost of the entire undertaking is $2,000,000, and it will take two years to complete the work. The power will be transmitted to Green Bay to run the street cars and to light that district. It is expected that over 5,000 HP. will be developed.

CLINTON IOWA.—Plans are being made by the Chicago & Northwestern R. R. Co. for the construction of a power-house, to be located on the bank of the Mississippi River, south of the railroad bridge, work on which will begin in the spring. The plant will furnish electricity for lamps, heat and power for the bridge, interlocking plants, switches, depot and other buildings. E. C. Carter, Chicago, is Ch. Engr.

BELOIT, KAN.—The contr... for furnishing and installing a Corliss ... gine direct connected to a ... ensing er-tor, and a 130-KW. belt-d... W. genera-for the municipal electric ... generator has been awarded to HOO... plant RENTSCHLER & CO., Cher... OWENS, Louis, Mo. The WESTING... Bldg., St. TRIC & MFG. CO., of Pitts... E. ELEC-furnish 20 arc lamps and ... Pa., will equipment. Burns & McIlo... electrical Bldg., Kansas City, Mo., are ... Scarritt

JUNCTION CITY, KAN.—T... directors of the Junction City Railway L... & Ice Co. have decided to make impro... nts to its system, to cost about $160,000 ... company is contemplating the installat... two 250-HP. boilers and new street ... and will make other improvements. W... Sweezey is Supt.

GREAT FALLS, MONT.—No... of the appropriation of water for two ... er plants between the Black Eagle Falls ... the Great Falls was filed in the office ... David M. Wood, Clerk and Recorder, on ... 28. The notice of appropriation filed ... signed by John G. Morony, Vice-Pres. ... the Great Falls Water Power & Town... Co. Each appropriation was for 1,000,000 ... or 25,000 cu. ft. of water per seco... and each appropriation provided that the power to be developed would be utilized in ... agricultural, horticultural, mining, ... chemical, manufacturing and ... developing power for plants and street railway lines within the state of Montana.

HUBBARD CITY, TEX.—We are officially advised that the Union Central Light & Ice Co., W. A. Bass, Pres., has procured franchises and completed surveys, plans and specifications for construction of the proposed electric light plant. The plant will cost $100,000 and will supply lighting and power and will manufacture ice. Engines, boilers, dynamos and wire will be required. Judson H. Boughton, Nation Light & Improvement Co., Pierce Bldg., St. Louis, Mo., is Engr.

DENVER, COLO.—Plans are being prepared by the Northern Colorado Power Co. for the construction of transmission lines in the northern part of the State, which will supply sufficient electrical power to pump water to irrigate 200,000 acres of land in the vicinity of Greeley, New Windsor and Fort Collins. The sub-station will be located at Windsor. Electrical energy will be transmitted from the Louisville power plant at 44,000 volts, 60 cycles, 3-phase to the sub-station, where it will be transformed to 2,300 volts for distribution. The cost of the work is estimated at $500,000. It is stated that arrangements are being made to operate the new sugar factory in Windsor by electricity. E. A. Mooney, Boulder, Colo., is Supt.

SEATTLE, WASH.—The City Council is considering the question of increasing the electric light plant and water-works system and increasing the proposed bond issue from $500,000 to $800,000. It is proposed to construct a dam about a mile and a half below the present dam on Cedar Creek, at an estimated cost of between $100,000 and $200,000; also to install a fifth water wheel and generator at the power plant. L. B. Youngs is Supt. of the municipal electric light plant and R. H. Thomson is City Engr.

CONDON, ORE.—The Wasco Electric & Water Power Co. has filed maps and definite locations of dam sites and power stations on the Deschutes and John Day Rivers with the State Engineer. Arrangements will be made soon for financing the project.

GEORGETOWN, CAL.—Notice of appropriation of 200 cu. ins. of water of Bear Creek, at what is known as Big Falls, has been filed by Norvall Douglass, Jr. The water power will be developed to generate electricity, which will be utilized for mining purposes.

RENO, NEV.—The following bids have been received for the construction of a dam across the Truckee River near the old smelter east of Reno, which has been purchased by the Nevada Commonwealth Mining & Milling Co. The following were the bidders and the amounts for which they offered to build a dam 134 ft. long, 8 ft. high and 5 ft. above the water level: M. J. Curtis, $3,200; Clinton & Higgins, $4,750; J. L. Forsyth, $4,935; Reno Construction Co., $7,200; Self & Sellman, $11,500.

*WINNIPEG, MAN.—Regarding the electrical work to be done by the City of Winnipeg at Point du Bois (advertised and noted last week) Smith, Kerr & Chace, Engrs., Confederation Life Bldg., Toronto, Ont., and Winnipeg, write us as follows: In 1906, the City of Winnipeg called upon a board of engineers for a report as to the available hydraulic power sites upon the Winnipeg River. On the advice received from those gentlemen, William Kennedy, Jr., of Montreal, Que., Col. H. N. Ruttan, City Engr., of Winnipeg, Man., and C. B. Smith, of Toronto, Ont., who reported on April 25 of that year, the City determined to proceed with the development of what was then known as the Thirty-foot Falls, a distance of 75 miles away. Complete designs for the power plant, transmission lines and terminal station were then prepared under the superintendence of Cecil B. Smith and throughout the past two seasons the construction of 25 miles of tramway has been proceeded with and is now completed. The Power Construction Department of the city under contract, is now engaged in the excavation of earth upon the site of the works, and bids are being called, returnable on Dec. 28, for the rock excavation, for the construction of concrete and other dams and for the power-house building, all at Point du Bois, Man. Bids are also being received for the supply of steel towers and transmission cable and for the erection of the transmission line between Point du Bois and Winnipeg. It is anticipated that these works will be rapidly proceeded with and that the city will be supplied with its own electric power at an early date. The ultimate capacity of the works will be 60,000 HP. under a head of 75 ft. of

water and the installation at present to be made will have a capacity of 20,000 HP. The Consulting Board of Engineers consists of Col. H. N. Ruttan, Chn. and William Kennedy, Jr., and Prof. L. A. Herdt. The construction will be carried on under Smith, Kerry & Chace, of Toronto, Ont., as Engrs.-in-Charge.

BRIDGES.

(denotes that this work is advertised in Engineering News.)*

SOUTH WINDSOR, CONN.—The citizens on Dec. 7 voted $10,000 for a new stone arch bridge over the Scantic River at East Windsor Hill.

NIAGARA FALLS, N. Y.—The Trans-Niagara Bridge Co., capitalized at $1,000,000, which is to build a bridge across the Niagara Gorge, has arranged to commence the preliminary work prior to Jan. 1, in order to conform to the terms of its charter. The New York State and Canadian Commissioners have selected a site about 300 ft. below or north of the upper steel arch bridge. The new bridge is to be used exclusively for electric railway service and for carrying power transmission lines. With the completion of the bridge through trolley express service will be inaugurated between Buffalo and Toronto and Rochester and Toronto.

CAZENOVIA, N. Y.—Bids are asked by F. C. Stevens, Supt. Pub. Wks., Albany, until noon, Dec. 22, for the construction of a plate-girder highway bridge over the outlet of Cazenovia Lake at Mill St.

PLATTSBURG, N. Y.—Bids will be received by the Board of Public Works until 7.30 p. m., Dec. 11, for the construction of a steel bridge. John Haughran is Chn. Bd. Noted on Dec. 3.

ROCHESTER, N. Y.—The following bids were received on Dec. 3 by F. C. Stevens, Supt. Pub. Wks., for constructing a lift bridge over the Erie Canal at Allen St., Rochester: M. FITZGERALD, Hoosick Falls, N. Y., $29,689 (awarded contract; W. J. Burns Co., Syracuse, N. Y., $31,070; Penn Bridge Co., Beaver Falls, Pa., $36,990; Montour Steel Co., Montour Falls, N. Y., $48,003; Houston Barnard, Rochester, N. Y., $37,453.

The following bids were received at the same time for a lift bridge at Lyell Ave., Rochester: W. J. BURNS CO., Syracuse, N. Y., $30,970 (awarded contract); Owego Bridge Co., Owego, N. Y., $44,775; Penn Bridge Co., Beaver Falls, Pa., $33,375; Seneca Engineering Co., Montour Falls, N. Y., $46,715; Houston Barnard, Rochester, N. Y., $35,392. Frederick Skene is State Engr.

*FORT HUNTER, N. Y.—Bids will be received by the Highway Commissioners of the towns of Glen and Florida, Montgomery County, at the office of W. Barlow Dunlap, Amsterdam, N. Y., until 1 p. m., Dec. 22, for the erection of a 2-span steel bridge across the Scholarie Creek here, and two concrete abutments and one pier, each span to be 228 ft. and 1 in. in length.

SCRANTON, PA.—The City Engineer is to prepare specifications for the construction of a bridge on Balloon St.

WILMINGTON, DEL.—The Baltimore & Ohio R. R. Co. is preparing to construct a stone bridge over Brandywine Creek here, to replace the present steel structure. Estimated cost, about $500,000.

BALTIMORE, MD.—The Merchants and Manufacturers' Association, Thomas Boggs, Secy., Baltimore St. and Hopkins Pl., on Nov. 30 appropriated $1,000 to pay for survey and a report upon the feasibility and approximate cost of constructing a bridge across Chesapeake Bay. Estimated cost, $5,000,000.

BARTON HEIGHTS (Richmond post-office), VA.—Bids are asked for the construction of four culverts, either of brick or concrete. T. Crawford Redd & Bro., 1017 Bank St., Richmond, are Engrs.-in-Charge.

AMELIA C. H., VA.—Bids are asked until Dec. 12, by the State Highway Department for replacing the old bridge at site or construction of new bridge over the Appomattox River between Amelia and Cumberland Counties. P. St. J. Wilson is State Highway Comr., Richmond, Va.

WHEELING, W. VA.—A new bridge will be constructed over Wheeling Creek at Market St. The plans of the City Engineer were approved on Nov. 30 by the City Council. Estimated Cost, $55,000.

ATHENS, GA.—The YORK BRIDGE CO., York, Pa., was awarded the contract on Nov. 25 by the city for the construction of a steel bridge here at $4,375. The new bridge will be of one span, 187 ft. in length. It will have a 16-ft. roadway and will be so constructed as to permit of the addition of sidewalks whenever the city and county determine to add them.

FREMONT, OHIO.—Plans are now being prepared by A. V. Brown, Engr., Lake Shore Electric Co., Norwalk, Ohio, for the construction of a bridge. Estimated cost, about $25,000.

NORWOOD (Cincinnati post-office), OHIO.—The County Commissioners, Cincinnati, are considering the construction of a viaduct over Duck Creek, to connect Norwood with Oakley.

CINCINNATI, OHIO.—The Board of Public Service has awarded the contract for the reinforcement and other structural work in connection with repairs to the Liberty St. viaduct to GRAINGER & CO., at about $25,000.

DAYTON, OHIO.—Specifications for the construction of the new concrete bridge at Needmore Road, over the Miami River, have been completed by Howard Kiepinger, County Engr.

GARY, IND.—Bids will soon be called for by Charles Johnson, County Audr., Crown Point, for the construction of a bridge across Little Calumet River at South Broadway, Gary. Estimated cost, about $37,000. W. T. Bridge, of Hammond, Ind., is Engr.

ATKINSON, ILL.—Bids are asked until Dec. 11 by H. E. Reeves, Engr., Mud Creek Special Drainage District, for the construction of 28 culverts with head walls.

*EVANSTON, ILL.—We are officially advised that bids were received as follows by the Board of Trustees of the Sanitary District of Chicago, American Trust Bldg., Chicago, on Dec. 2, for the superstructure of the Chicago, Milwaukee & St. Paul Ry. bridge, the work consisting of the fabrication, erection and completion of the superstructure of a railroad bridge at the crossing of the Chicago, Milwaukee & St. Paul Ry. over the North Shore Channel of the Sanitary District of Chicago, near Chancellor St., Evanston: Wisconsin Bridge & Iron Co., Monadnock Bldg., Chicago, $38,375; Fort Pitt Bridge Works, House Bldg., Pittsburg, Pa., $41,900; George W. Jackson, Inc., Borland Bldg., Chicago, Ill., $42,496; Strobel Steel Construction Co., Monadnock Bldg., Chicago, $42,880; National Contracting Co., Tacoma Bldg., Chicago, $43,157; Chicago Bridge & Iron Works, 105th and Throop Sts., Chicago, $43,270; Worden-Allen Co., 184 La Salle St., Chicago, $44,891; King Bridge Co., Cleveland, Ohio, $45,780; Roenhelt Construction Co., Chicago, $45,900; The Penn Bridge Co., Beaver Falls, Pa., $46,300; The Toledo-Massillon Bridge Co., Toledo, Ohio, $46,900; The Pennsylvania Steel Co., Chicago, $47,790. I. J. Bryan is Clk.

MILWAUKEE, WIS.—We are officially advised that the Board of Public Works has awarded the contract for the construction of a bascule bridge across the Milwaukee River at East Water St., complete with foundations, to A. H. VOGEL, Milwaukee, at $139,785. Bids were opened on Dec. 4. Charles J. Poetsch is City Engr.

DES MOINES, IOWA.—The Chicago, Rock Island & Pacific Ry. Co., J. B. Berry, Ch. Engr., Chicago, Ill., is having plans prepared for a viaduct to be constructed at Seventh St. Estimated cost, $130,000.

MINNEAPOLIS, MINN.—Bids will be received by Hugh R. Scott, County Audr., Hennepin County, until Dec. 14 for the construction of a bridge.

MISSOULA, MONT.—The County Commissioners on Nov. 23 opened bids as follows for constructing the Higgins Ave. Bridge: C. G. Sheely, Denver, Colo., $143,750; BURREL BRIDGE CO., Oakland, Cal., $134,716 (awarded contract); William Oliver Bridge Co., Spokane, Wash., $162,500; Milwaukee Bridge Co., Milwaukee, Wis., $153,000; Midland Bridge Co., Kansas City, Mo., $144,288; Missouri Valley Bridge & Iron Co., Leavenworth, Kan., $143,500; Minneapolis Steel & Machinery Co., Minneapolis, Minn., $154,675; Bayne & Hewitt, Minneapolis, Minn., $172,490; Modern Steel Structural Co., Waukesha, Wis., $166,230; Pittsburg Construction Co., Pittsburg, Pa., $169,909.

COLUMBUS, MONT.—The Board of County Commissioners of Carbon, Sweet Grass and Yellowstone Counties has let the contract for the construction of a bridge over the Yellowstone River near Columbus to the SECURITY BRIDGE CO., of Minneapolis, Minn. Estimated cost of bridge, $19,900.

BATESVILLE, ARK.—Bids are asked by Cul L. Pearce, County Judge, Independence County, until noon, Dec. 19, for the construction of steel highway viaducts and bridges. Lund & Hill are Engrs., Little Rock, Ark.

OKANOGAN, WASH.—The County Commissioners have awarded the contract for a steel bridge here to the PUGET SOUND BRIDGE & DREDGING CO., at $10,500.

NEWPORT, ORE.—Bids are asked by the County Court of Lincoln County until Jan. 1, for the rebuilding of the Elk City bridge over Big Elk River, bidders to furnish plans and specifications.

FRESNO, CAL.—Bids will be received by the Board of Supervisors until 2 p. m., Dec. 11, for the construction of a pile bridge across Kings River. W. O. Miles is Clk.

BARRIE, ONT.—The contract for constructing the substructure of a bridge over Nottawasaga River at Vanvlack has been awarded to PRATT & McDOUGALL, of Midland, at $7,000, and the superstructure to A. HILL & CO., of Mitchell, at $7,642.

NEW WESTMINSTER, B. C.—The INTERNATIONAL CONTRACT CO., Seattle, Wash., has been awarded the contract for the substructure of the Lulu Island bridge, at $29,642. The CANADA FOUNDRY CO. has the contract for the superstructure, at $26,891.

BUILDINGS.

(denotes that this work is advertised in Engineering News.)*

SPRINGFIELD, MASS.—We are officially advised that Pell & Corbett, Archs., 122 East 25th St., New York, have been selected by the City Hall Commission to prepare plans for a city-hall which is to cost $1,100,000, according to the estimate of the Commission.

ATTLEBORO, MASS.—Cooper & Bailey, Archs., 60 Congress St., Boston, let contract to WILLIAM WILLIAMS, of Providence, R. I., for a 6-room and hall school building, to be erected at Attleboro, at a cost of $50,000.

BOSTON, MASS.—The NORCROSS BROS. CO., Worcester, have been awarded the contract for a building to be built for the Boston Safe Deposit & Trust Co., Boston. Estimated cost, $1,000,000.

The Masonic Building Association has had plans prepared by Edward I. Wilson, 101 Tremont St., for a building to cost $50,000. William Martin, of Chelsea, Mass., is Pres. of the association.

NEW BEDFORD, MASS.—Plans have been submitted to the Board of Education by Clough & Wardner, Archs., 46 Cornhill, Boston, Mass., for a high school building to be erected on County St.

PROVIDENCE, R. I.—Bids are asked by Charles R. Makepeace, Chn. Com. on City Property, City Hall, until 2 p. m., Dec. 16, for the construction of a 12-room grammar school building on Veazie St., near Douglas Ave. Separate bids on heating, plumbing and electrical work will be received. Clarke, Howe & Homer, 72 Weybosset St., Providence, are Archs.

DANBURY, CONN.—William H. Isham, of New York, will receive estimates for a 3-story theater, lodge room and club building, to be built at Danbury, for himself. Cost, $80,000.

STAMFORD, CONN.—Bids are asked by the Town of Stamford until Dec. 17, to local bidders only, for constructing a high school addition to cost $50,000. The building will be three stories high and 90 × 90 ft. Boring & Tilton, 32 Broadway, New York, are Archs.

FORT SLOCUM (New Rochelle post-office), N. Y.—Bids are asked until 10 a. m., Jan. 6, by the Constructing Quartermaster, for construction, plumbing, steam heating and electric wiring one 4-set officers' quarters, one double set Lieutenants' quarters, four double sets N. C. O. quarters, and one garbage crematory.

EDGEMERE (Far Rockaway post-office), N. Y.—John E. Nitchie, Arch., 150 Nassau St., New York, has prepared plans for a 3½-story hotel at Edgemere. Cost, $40,000.

NEW YORK, N. Y.—We are officially advised that estimates are being taken for a 6-story apartment house, 100 × 100 ft., with 35 suites of apartments, to be built for James O'Brien and M. Cravatta, 647 Sixth Ave., owners, at the corner of Broadway and 164th St. It is to be of the Renaissance type, with mezzanine bays and facades of brick, and trimmings of limestone and terra cotta. It is to cost $175,000. Denby & Nute, 333 Fourth Ave., are Archs.

NEW YORK, N. Y.—The following bids were received on Dec. 3 by John W. Stevenson, Comr. of Bridges, for construction of the foundation for the Municipal Building, to be erected at the Manhattan end of the Brooklyn Bridge: (a) price per cu. yd for excavation, (b) total: P. J. Carlin Construction Co., 16 East 23d St., (a) $34, (b) $786,000; R. E. Henningham, 1 Madison Ave., (a) $40, (b) $854,000; Arthur McMullen, Park Row Bldg., (a) $10, (b) $865,000; Tide Water Bldg. Co., 25 West 26th St., (a) $22.50, (b) $838,500; Gaffeny & Stiers, (a) $10, (b) $824,000; J. H. Gray Co., Broadway and 23d St., (a) $15, (b) $622,000; J. C. Rogers, (a) $40, (b) $673,750; New England Construction Co., Exchange Bldg., Boston, Mass., (a) $30, (b) $871,731; Thomas Cockerill & Son, 147 Columbus Ave., (a) $35, (b) $784,000.

Bids are asked by John V. Coggey, Comr. Dept. of Correction, 148 East 20th St., until 11 a. m., Dec. 15, for furnishing all labor and material required to install new steel grilles to galleries of male prison, cell blocks A, B, C and D, temporary corrugated iron protection fence in prison yard, and other sheet iron and ornamental wrought iron work, etc., at the City Prison, Raymond St., Boro. of Brooklyn.

Allen & Collins, 1170 Broadway, and L. E. Jallade, 178 Fifth Ave., Archs., are preparing preliminary plans for a church for the Second Congregational Society. Cost, $100,000.

Plans have been filed with the Buildings Superintendent for enlarging the 11-story loft building at 203 and 205 West 24th St., by adding an 11-story annex on the east with a frontage of 43 ft. and a depth of 98.8 ft. The improvement is to be made for the Franmor Realty Co., S. O. Rosenbaum, Pres. It is to cost $80,000. Ditmars & Brite, 111 Fifth Ave., are Archs.

NEW YORK, N. Y.—Bids are asked until 2.30 p. m., Dec. 16 by Robert W. Hebberd, Comr. Dept. of Public Charities, for furnishing all the labor and material required to put new roofs on the following buildings: Pavilion A-B-C, School for Feeble-minded, Day School, laundry buildings, Dormitory No. 2, Ward 11, Ward 14, Ward 15, Old Pavilion "F," and office building, Randall's Island.

Bids are asked until 3 p. m., Dec. 17, by the Park Board, Henry Smith, Pres., for all labor and materials required for the erection and completion of an addition to the Metropolitan Museum of Art, for the Boscoreale Collection, located in Central Park, on the west side of Fifth Ave., Boro. of Manhattan.

Wagenhals & Kemper, Astor Theatre, are to erect a theatre adjoining the Lambs Club, on West 44th St., between Broadway and Sixth Ave., it is stated. It is to be known as the Annie Russell. It will have a frontage of 131 ft. on 44th St. and a depth of 100 ft. The property is valued at $375,000. The building will cost about $300,000.

A $200,000 theater is to be built at the corner of 53d St. and Sixth Ave., from plans by George Keister, Arch., 11 West 29th St., by the John E. Olson Co., owner of the property. The building will have a frontage of 64 ft. and a depth of 70 ft., and will be constructed of brick, with terra cotta trimmings. Its design will be classic. There will be tall Ionic pilars, supporting a pediment, and an ornamental cornice. The height in the auditorium part of the building from the orchestra to the ceiling will be 53 ft. There will be two balconies. The height of the stage will be 70 ft. It is expected the theater will be ready for use early next fall.

NEW YORK, N. Y.—We are advised by McLellan & Beadel, Archs., 1123 Broadway, that they will take estimates for a 5-story brick and stone residence to be erected by Mrs. Louis T. Hoyt, 992 Fifth Ave., at 726 Fifth Ave. The building will be 25 × 62.8 ft. and will cost $38,000.

New York Lodge, No. 1, Benevolent Order of Elks, has closed negotiations for the purchase of the properties 108 to 116 West 43d St., between Sixth Ave. and Times Sq., and will erect on the site a 12-story building, which will contain a clubhouse, theater and lodge room. The lot has a frontage of 100 ft. on the south side of 43d St., directly opposite the Army and Navy Club, and is now occupied by five old dwellings. The purchase was arranged by P. A. Geoghegan, Chn. of the Bldg. Com. of the lodge. Ground and building, it is estimated, will involve an investment of $1,000,000.

It is stated that the Equitable Life Assurance Society has decided to begin the construction of its 62-story building on the site of its present structure at 120 Broadway. D. H. Burnham & Co., Archs., Railway Exchange, Chicago, have drawn plans for the structure, and it is said that the plans are now in the hands of the Equitable officials. The plans are said to call for accommodations for 60,000 persons.

We are officially advised that Charles B. Meyers, Arch., 1 Madison Ave., has prepared plans for two 6-story brick and stone store and tenement buildings, 50 × 85.9 ft., to cost, together, $100,000. The structures will be built at 329 and 337 East 32d St., for the Tolchester Co., 135 Broadway.

NEW YORK, N. Y.—The following bids were received on Nov. 30 by Robert W. Hebberd, Comr. Dept. of Public Charities, for the excavation, masonry, steel and iron work, roofing and metal work, carpentry, electric work, heating and ventilating work, plumbing work and all other work, as set forth in the drawings and specifications for the construction and entire completion of a tuberculosis infirmary, for the Metropolitan Hospital District, Blackwell's Island, Boro. of Manhattan: Joseph D'Benedetto, $420,937; F. T. Nesbit Co., Inc., 116 Nassau St., $335,000; George Vassars Sons & Co., 1123 Broadway, $317,000; Kelly & Kelley, Inc., 45 East 42d St., $315,708; Thomas B. Leahy Building Co., 25 West 42d St., $307,743; Bottsford Dickenson Co., 1170 Broadway, $291,921.

Bids are asked by Robert W. Hebberd, Comr. Dept. of Public Charities, until 2.30 p. m., Dec. 17, for the excavation, masonry, steel and iron work, roofing and metal work, carpentry, electric work, heating and ventilating work, plumbing work and all other work, as set forth in the drawings and specifications for the construction and entire completion of a tuberculosis infirmary for the Metropolitan Hospital District, Blackwell's Island, Boro. of Manhattan.

NEW YORK, N. Y.—The following bids were received on Nov. 30, by John W. Brannan, Pres. Bd. of Trustees, Bellevue and Allied Hospitals, for the excavating, piling, mason, fireproofing, waterproofing, carpenter, steel, electric, heating and ventilating, plumbing and other work for the boiler house and coaling station of the new Bellevue Hospital, situated on First Ave. and bounded by 26th and 27th Sts., Boro. of Manhattan: North Eastern Construction Co., $423,900; M. Ried & Co., 116 West 30th St., $450,000; Richard E. Henningham, 1 Madison Ave., $419,829; Phoenix Construction Co., Park Row Bldg., $497,897; Thompson Starrett Co., 45 Wall St., $500,000; Thomas Cockerill & Sons, 147 Columbus Ave., $408,895; McHarg Barton & Co., 299 Broadway, $492,000; Charles H. Peckworth, 415 Hudson St., $397,700; The P. J. Carlin Construction Co., 16 East 23d St., $394,600.

The United States Realty & Construction Co. has decided to erect a 9-story automobile building on the plot, 66 × 116.5 ft., at the corner of Broadway and 57th St., and has closed negotiations for leasing the building for a term of years to a motor car concern.

NEW YORK, N. Y.—Bids are asked until 11 a. m., Dec. 21, by C. B. J. Snyder, Supt. of School Bldgs., Dept. of Education, for alterations, repairs, etc., at Girls' High School and Public Schools Nos. 21, 24, 26, 36, 53, 57, 63, 70, 74, 84, 109, 117, 123, 137, 144, 147 and 150, Boro. of Brooklyn; for new retaining wall, sidewalk, etc., at Public School No. 154, on Eleventh Ave., Braxton and Sherman Sts., Boro. of Brooklyn; for alterations, repairs, etc., at Training School for Teachers, Park Pl., west of Nostrand Ave., and Commercial High School, Albany Ave., Bergen and Dean Sts., Boro. of Brooklyn; for alterations and additions to electric equipment in Public School No. 13, on 216th St. and Willett Ave., Williamsbridge, Boro. of the Bronx; for forming offices, etc., on the second story of the hall of the Board of Education, Park Ave. and 59th St., Boro. of Manhattan.

KINGSTON, N. Y.—The contract for constructing a museum for the Washington's Headquarters at Kingston, N. Y., has been awarded to GEORGE SYKES, 1123 Broadway, New York, for $24,572.

*BUFFALO, N. Y.—Bids are asked until 3 p. m., Dec. 23, by the State Commission in Lunacy, Capitol, Albany, for additions to Eulmwood Building: additional verandas, Wards 3, 4, 5 and 6; boiler-room, roof extension; construction, including heating, plumbing and electric work, at the Buffalo State Hospital, Buffalo, N. Y. T. E. McGarr is Secy.; Franklin B. Ware is State Arch., Albany.

ROCHESTER, N. Y.—James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., has awarded to the OTIS ELEVATOR CO., 17 Battery Pl., New York, contract for installing an electric elevator in the U. S. post-office at Rochester, N. Y., at $7,845.

WHITE PLAINS, N Y.—Bids are asked until noon, Dec. 16, by the State Armory Commission for the construction of a state armory at White Plains, N. Y. All the bids received on the Nov. 10 letting were rejected as excessive. The plans and specifications have now been revised in order to reduce the cost of the work. The appropriation is $75,000. Major F. A. McNeeley is Secy. F. B. Ware is State Arch., the Capitol, Albany, N. Y.

BRIDGETON, N. J.—Watson, Huckel & Co., 1211 Walnut St., Philadelphia, Pa., Archs., have completed plans for the 3-story court-house for the Cumberland County Commissioners, Bridgeton. Cost, $125,000.

HARRISBURG, PA.—The State Board of Public Grounds and Buildings, H. D. Jones, Secy., will have plans prepared for rebuilding the 4-story arsenal. It will be of brick and steel, with stone trimmings, slag roof, cement and concrete work, electric wiring, sheet metal and steam heat. Cost, $50,000.

CARLISLE, PA.—Bids were received as follows Dec. 2 at the office of James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for the construction of a post-office at Carlisle, Pa.: James D. Doak & Co., Philadelphia, $56,700; J. E. & A. L. Pennock, Philadelphia, $58,400; Ambrose B. Stannard, New York, $62,000; John G. Unkefer & Co., Minerva, Ohio, $54,400; McHenry-Beatty Co., East Liverpool, Ohio, $59,946; Ahrens Construction Co., Inc., Lewistown, Pa., $76,200; George A. Glenn & Co., Philadelphia, $56,200; Walter Titus, Philadelphia, $59,300; Durolithic Co., Buffalo, N. Y., $63,000; M. P. Wells, Philadelphia, $55,685; David M. Andrews Co., Baltimore, $59,400; Wilmarth Bldg. Co., New York, $58,173; John A. Carter Co., Swathmore, Pa., $64,377; W. H. Fissell & Co., New York, $62,921; John W. Emery, Philadelphia, $71,645; William R. Compton Realty & Bldg. Co., Elmira, N. Y., $63,816. Time, Dec. 1, 1909.

PHILADELPHIA, PA.—Bids are asked by the Board of Education, until Dec. 29, for constructing two 3-story fireproof school buildings, 80 × 180 ft. The buildings will be of brick and stone construction and will cost $400,000. J. Horace Cook, 742 City Hall, is Arch. Bd. of Education.

PHILADELPHIA, PA.—C. Howard Clark, a member of the banking firm of E. W. Clark & Co., has commissioned Zantzinger & Borie, Archs., 251 South Fourth St., to prepare plans for a stone and frame house, stable and conservatory, which he will have erected at "Netterville," the Christopher Fallon estate, south of Devon.

SCRANTON, PA.—The Traders' National Bank, J. T. Porter, Pres., Spruce and Wyoming Sts., contemplates erecting an addition to its bank and office building, on premises, it is stated. The building will have seven stories, 45 × 145 ft., and will be constructed of brick, stone, terra cotta, steel and fireproofing. Cost, $75,000.

CUMBERLAND, MD.—J. Riely Gordon, Arch., 244 Fifth Ave., New York, has let general contract to WILLIAM H. FISSELL & CO., 1133 Broadway, New York, for a 6-story bank and office building for the Interstate Trust Co., Cumberland. Cost, $150,000.

WASHINGTON, D. C.—The Superintendent of the new National Museum building, Washington, has awarded contract for the construction of the marble work in the stairways, halls and toilet rooms of the new building, to VERMONT MARBLE CO., Proctor, Vt., at $30,320.

GAINESVILLE, GA.—Bids were received as follows Dec. 8 at the office of James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for the construction of U. S. post-office building at Gainesville, Ga.: George A. Clayton & Co., Atlanta, Ga., $65,193; David Getaz Son & Co., Knoxville, Tenn, $68,800; Thomas J. Turner, Knoxville, Tenn., $77,248; Gude & Co., Atlanta, Ga., $66,900; George Becking, Chattanooga, Tenn., $61,800; Wilmarth Construction Co., New York, $69,000; Ambrose B Stannard, New York, $67,000; Robt. E. Pharrow, Atlanta, Ga., $63,670; Cecil L. Saunders, Cleveland, Ohio, $63,000; Miles & Bradt Co., Atlanta, Ga., $64,000; Nashville Bldg. Co., Nashville, Tenn., $59,000. Time, Dec. 31, 1909.

PENSACOLA, FLA.—Bids are asked by F. F. Bingham, Secy. Bldg. Com., Pensacola, Hotel Co., until 3 p. m., Dec. 16, for the general construction of an 8-story fireproof hotel. W. L. Stoddart, 31 Union Sq., New York, is Arch.

GAINESVILLE, FLA.—Bids are asked until 3 p. m., Jan. 11, by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. post-office at Gainesville.

JOHNSON CITY, TENN.—Bids are asked until 3 p. m., Jan. 7, by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for the construction, complete, of the U. S. post-office at Johnson City.

MEMPHIS, TENN.—Shaw & Pfeil, Archs., Tennessee Bldg., Memphis, are completing plans for a 2-story bank building for the Manhattan Savings Bank & Trust Co., Hirsch Morris, Pres. Estimated cost, $50,000.

*MURFREESBORO, TENN.—Bids are asked by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., until 3 p. m., Jan. 9, for the construction (complete) of the U. S. post-office at Murfreesboro, Tenn.

HODGENVILLE, KY.—The NORCROSS BROS. CO., Worcester, Mass., has secured contract to construct a museum at Hodgenville for the Lincoln Memorial Association. Cost, $100,000.

CINCINNATI, OHIO.—We are officially advised that the proposed building of the Ohio Mechanics' Institute, John L. Shearer, Principal, for which Samuel Hannaford & Sons, Archs., Hulbert Block, have been retained to prepare plans, will consist of a hall, with a seating capacity of 2,000, to be known as the Emery Auditorium; a special wing, 180 × 232 ft., five stories and basement, for shops. The remainder of the building will be used for laboratories, testing rooms, recitation rooms, library and exhibition rooms for industrial products. Architects will let contracts probably in February. It is the intention to have the building finished by the opening of school in 1910. Cost of building, $500,000; equipment, $250,000.

COLUMBUS, OHIO.—Bids are asked by the State Board of Agriculture until noon, Dec. 29, for the erection of a women's building on the State Fair Grounds. Dawson & Holbrook, Outlook Bldg., Columbus, are Archs.

CLEVELAND, OHIO.—Contract has been let by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., to JOHN GILL & SONS, Citizens Bldg., Cleveland, at $774,386, for the completion of the U. S. post-office at Cleveland. A list of bids was given on Nov. 12.

Plans have been agreed upon and construction work on the building of the Brotherhood of Locomotive Engineers, St. Clair Ave. and Ontario St., will be started in March. Warren S. Stone is Grand Chief. The structure will be finished by March, 1910. In the competition of architects the design of Knox & Elliott, Rockefeller Bldg., was adopted. The exterior is to be of white glazed terra cotta. The office entrance will be on Ontario St. and on St. Clair Ave., there will be an elaborate auditorium entrance. The building which is to represent an expenditure of $1,000,000 will be twelve stories high, fronting 124 ft. on Ontario St. and 178 ft. on St. Clair Ave. In addition to the auditorium on the first floor there will be 7,000 ft. of rentable floor space. On each of the other floors there will be 11,000 sq. ft. of office floor space. In the center there will be a light court extending from the roof to the ceiling of the auditorium. It will be 80 × 84 ft.

HAMILTON, OHIO.—The Board of Trustees of Miami University have awarded the contract for the new library to LUYSTER & LOWES, of Dayton, Ohio. The price is $61,750. The structure will be fireproof. The exterior will be of Bedford stone and pressed brick and the interior of stone and terra cotta. HARRY KARG, of Westerville, Ohio, has secured the contract for the Normal College Building, at $40,089.

KANKAKEE, ILL.—T. B. Bratton, Chn. County Bd., advises us that Kankakee County will erect a court-house in this city, to cost $200,000. The building will be fireproof. Bids probably will be called for in January or February.

PARIS, ILL.—Bids are asked until 3 p. m., Jan. 6, by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. post-office at Paris.

PEORIA, ILL.—Plans are being prepared by Herbert E. Hewitt, Main St., Arch., for a Shriners' Temple, 96 × 172 ft., on Monroe St. It will be of press brick with terra cotta trimmings and will cost $100,000. Bids will be asked for about Jan. 10.

Jenney, Mundie & Jensen, Archs., New York Life Bldg., Chicago, have let general contract to the WESTLAKE CONSTRUCTION CO., 717 Locust St., St. Louis, Mo., for the bank and office building for the Jefferson Safe Deposit Co., Peoria. Cost, $450,000.

CHICAGO, ILL.—The Chicago "Record-Herald" states that Rev. John Kosinski of St. Stanislaus College is interested in establishing a Polish educational institution at Milwaukee and Belmont Aves. Plans have been drawn for a group of buildings to cost $500,000.

C. A. Eckstrom, Arch., Tacoma Bldg., is receiving bids for a theater and office building for O. Heyworth. Cost, $500,000.

A site has been purchased by the city for a central police station. The site has a frontage of 110 ft. on Madison St. and 200 ft. on the Chicago River.

Plans are being prepared by Frost & Granger, Archs., The Temple, for a veterinary college and hospital for the University of Illinois. Cost, $250,000.

CHICAGO, ILL.—The NOEL CONSTRUCTION CO., German and Calvert Sts., Baltimore, Md., has been awarded the contract at $3,295,000, to build the proposed city hall.

GREEN BAY, WIS.—The Board of Education will erect a school, to be known as the West Side High School, and to cost $125,000. J. C. Llewellyn, First National Bank Bldg., Chicago, Ill., is Arch.

GRANDON, WIS.—F. D. Orff, Arch., Lumber Exchange, Minneapolis, Minn., has completed plans for a 2-story court-house for the County Board of Supervisors of Forest County, Crandon. The building is to cost $60,000.

CROOKSTON, MINN.—James Knox Taylor, Supervy. Arch., Treasury Dept., has awarded to the NORTHERN CONSTRUCTION CO., Milwaukee, Wis., contract for the construction of a post-office at Crookston, Minn., at $68,884. Time, Dec. 1, 1909.

NEW ULM, MINN.—James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., has awarded contract for the construction of a post-office at New Ulm, Minn., to STEWART & HAGER CO., Janesville, Wis., at $41,950. Time, Jan. 1, 1910. A list of bids was given on Nov. 26.

MINNEAPOLIS, MINN.—Plans are being prepared by L. A. Lamoreaux, Lumber Exchange, city, for the construction of a 3-story pressed brick and cut stone men's clubhouse to be built on the State University campus. E. B. Johnson, city, is Secy. of the Alumni Association. Cost, $60,000.

DULUTH, MINN.—James Knox Taylor, Superv. Arch., Treasury Dept., has awarded to the OTIS ELEVATOR CO., 17 Battery Pl., New York, contract for the installation of an electric elevator in the Duluth post-office, at $4,391.

IOLA, KAN.—James Knox Taylor, Supervy. Arch., Treasury Dept., Washington, D. C., has awarded to DIETER & WENZEL CONSTRUCTION CO., of Wichita, Kan., contract for the construction of a post-office building at Iola, at $52,172. Time, Dec. 31, 1909.

NEWTON, KAN.—The following bids were received by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., on Dec. 1 for the construction complete of the U. S. post-office at Newton, Kan.: Wurster Construction Co., Wichita, Kan., $47,412; Parsons & Kiene, Omaha, Neb., $40,541; M. Yeager & Son, Danville, Ill., $40,906; Cook Construction Co., Des Moines, Iowa, $61,882; E. A. Steininger Construction Co., St. Louis, Mo., $52,758; Dieter & Wenzel Construction Co., Wichita, Kan., $48,776; Carl A. Nilson, Kansas City, Mo., $43,070; F. H. Latimer, Kansas City, Mo., $53,842.

WICHITA, KAN.—E. L. Masqueray, Arch., St. Paul, Minn., is preparing plans for a cathedral for the Diocese of Wichita. Cost, $125,000.

ST. LOUIS, MO.—Bids are asked until Jan. 15 by the Board of Public Improvements for the erection of a maniacal building as an annex to the Insane Asylum, at an estimated cost of $70,000.

HOUSTON, TEX.—Bids are asked until noon, Dec. 15, by A. E. Amerman, County Judge, for furnishing and installation of power, heating, vacuum sweeping system, plumbing, electrical wiring and elevator for the proposed Harris County court-house. Lang & Witchell, Wilson Bldg., Dallas, Tex., are Archs.

BOULDER, COLO.—Bids are asked until Dec. 14, for erection of the Guggenheim Law School building for the University of Colorado. It will be three stories high, will be built of stone and gray brick and will cost $45,000.

TRINIDAD, COLO.—James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., has awarded contract for the construction of a post-office building at Trinidad, Colo., to DIETER & WENZEL CONSTRUCTION CO., Wichita, Kan., at $65,799. Time, Jan. 1, 1910. A list of bids was given on Nov. 26.

LOS ANGELES, CAL.—The general contract for the construction of the W. P. Story building at Sixth St. and Broadway has been let by Morgan & Wall, Archs. The contract for the superstructure has been let to WEYMAN & CROWELL, Pacific Electric Bldg., at $199,000.

SAN FRANCISCO, CAL.—The RANSOME CONCRETE CO., Crocker Bldg., has the contract to construct the proposed Columbia Theater at Geary and Mason Sts. This contract includes everything except painting and decorating. Bliss & Faville, 15 Second St., are Archs.

The Board of Public Works has awarded the contract for the concrete, brick and stone work on the Mission grammar school for $101,500 to the KITTLE CONSTRUCTION CO., Sutter and Stockton Sts.

SAN FRANCISCO, CAL.—The proposed building of the London-Paris National Bank will be a 1-story granite structure. It will be located at the corner of Sansome and Sutter Sts., on a lot 46 × 123 ft. Albert Pissis is Arch., James Flood Bldg.

SACRAMENTO, CAL.—Bids are asked until 2 p. m., Dec. 12, by the State Agricultural Society, State Capitol, Sacramento, for constructing a complete building known as Agricultural Pavilion, and also a complete building known as Manufacturers' Pavilion, to be erected on the grounds at Agricultural Park, near the City of Sacramento. J. A. Filcher is Secy.; Sellon & Hemmings, 251 Kearny St., San Francisco, Cal., are Archs.

SAN JOSE, CAL.—Bids are asked until 3 p. m., Dec. 26, by M. E. Dailey, Secy. Bd. of Trustees of the San Jose State Normal School, San Jose, for construction of Normal School buildings. Sellon & Hemmings, 251 Kearny St., San Francisco, Cal., are Archs.

LETHBRIDGE, ALTA.—The city will erect a hospital at a cost of $60,000. G. W. Robinson is interested.

MEDICINE HAT, ALTA.—Bids will be received by N. Tessier, Secy. of the Dept. of Public Works, Ottawa, Ont., until 4 p. m., Dec. 17, for the construction of a post-office, customs and inland revenue public building, according to plans which may be seen at the office of W. T. Williams, Superv. Arch., Medicine Hat, and also at the Department of Public Works, Ottawa.

VICTORIA, B. C.—The Royal Bank is arranging for the erection of a 3-story bank building on Government St. Work will start at once. T. D. Veitch is Local Mgr.

VANCOUVER, B. C.—Plans have been accepted for a hospital to be erected here at a cost of $55,000. Dr. A. B. Underhill.

VERNON, B. C.—Bids for the public buildings to be erected here by the Dominion Government have been extended until Dec. 30. N. Tessier is Secy. Dept. of Pub. Wks., Ottawa, Ont.

WATER SUPPLY—IRRIGATION.

(* *denotes that this work is advertised in Engineering News.*)

BURLINGTON, VT.—The contract for boring an artesian well at the reservoir site has been awarded to D. P. HOADLEY, of Middletown Springs, Vt., at $3.60 per ft.

*SPRINGFIELD, MASS.—We are officially advised that bids were received on Dec. 4 by the Board of Water Commissioners for the construction of the Borden Brook dam and reservoir, contract No. 5, Little River Water Supply: Cement Paving & Construction Co., 1 Montgomery St., Jersey City, N. J., $146,450; Robert K. Everett & Co., Tarrytown, N. Y., $148,300; Coleman Bros., 15 Court Square, Boston, Mass., $169,875; Shanley-Morrissey, Inc., 527 Fifth Ave., New York, $171,000; Pennell, O'Hern & Merritt, Yonkers, N. Y., $180,650; F. T. Ley & Co., Inc., Springfield, Mass., $181,150; T. Stuart & Son Co., Newton, Mass., $183,040; Pierson Engineering & Construction Co., Bristol, Conn., $207,350; Bruno & Petitti, 18 Tremont St., Boston, $212,200. E. E. Lochridge is Ch. Engr., Comrs. Itemized bids are given under Contract Prices in this issue.

NEW YORK, N. Y.—Bids are asked until 2 p. m., Dec. 17, by John H. O'Brien, Comr. Water Supply, Gas and Electricity, for furnishing and delivering c.-i. water pipe, branch pipe and special castings for high pressure fire service.

AMSTERDAM, N. Y.—We are officially advised that the following bids for c.-i. pipe and special castings for Hanns Creek conduit No. 2 were received on Dec. 4 by the Board of Water Commissioners: R. D. Wood & Co., Philadelphia, Pa., f. o. b. cars, Amsterdam, 30-in. straight pipe, per net ton, $24.30; 24-in. straight pipe, $24.30; smaller sizes straight pipe, $23.90; special castings pipe, per lb., 2½ cts.; f. o. b. cars, Broadalbin, N. Y., 30-in. straight pipe, $25.50; 24-in. straight pipe, $25.50; smaller sizes straight pipe, $25.10; special castings, 2½ cts. U. S. Cast Iron Pipe & Foundry Co., f. o. b. car, Amsterdam, 30-in. straight pipe, $23.90; 24-in. straight pipe, $23.90; smaller sizes straight pipe, $23.90; special castings pipe, 2½ cts.; f. o. b. cars, Burlington, 30-in. straight pipe, $24.70; 24-in. straight pipe, $24.70; smaller sizes straight pipe, $24.70; special castings pipe, 2½ cts. Contract was awarded to the U. S. CAST IRON PIPE & FOUNDRY CO., 71 Broadway, New York. Frank H. McConnell is Secy.

*NEW YORK, N. Y.—Bids were received as follows on Dec. 1 by the Board of Water Supply for constructing the [illegible] of the Walkill pressure tunnel, [illegible] Contracts Nos. 36-37, and 38 and 37: Contract No. 36—American Pipe Mfg. Co., Fidelity Bldg., Philadelphia, Pa., $2,005,185; Mallard Construction Co., Pennsylvania Bldg., Philadelphia, Pa., $2,031,180; McArthur Bros. Co., 1 Pine St., New York, $2,045,595; Reinhardt, Ennis, Washington, D. C., $2,140,529. Contract No. 37—American Pipe Mfg. Co., $1,[illegible]; Mallard Construction Co., $1,889,6[illegible]; Gore Co., 206 Broadway, New York, $1,[illegible]; Henning Co., Richmond, Ky., [illegible]. Contracts 36 and 37—Booth & Flynn, 1942 Forbes St., Pittsburg, Pa., $3,[illegible]; Bradley Contracting Co., 1 Madison Ave., New York, $3,829,030; S. Pearson & Son, Inc., Long Island City, New York, $3,910,1[illegible]; American Pipe Mfg. Co., $3,743,032; Arthur McMullan and Winston & Co., Park Row Bldg., New York, $3,345,159; McArthur Bros. and Mason & Henning Co., 11 Pine St., New York, $4,254,642.

ORANGE, N. J.—Bids will be received by Willet B. Gano, City Clk., Orange National Bank, Orange, until Dec. 17 for the purchase and removal of water pumping machinery at Campbell's Pond reservoir, Milburn.

WASHINGTON, PA.—The contract for the construction of water-works at the sewage disposal plant was awarded by the Council on Nov. 24 to A. B. WILSON, of Washington, representing the Reineke-Wagner Pump & Supply Co., 420 First Ave., Pittsburg, at $3,500, the Gardner engine to be used.

LEMOYNE, PA.—The Riverton Consolidated Water Co. contemplates constructing a filter plant.

*GADSDEN, ALA.—The U. S. CAST IRON PIPE & FOUNDRY CO., Chattanooga, Tenn., has secured the contract for furnishing 50,400 ft. of c.-i. pipe from 4 to 16-in. diameter, approximately 1,250 tons, and 65 tons of special castings at a total of $26,272. Bids were opened on Nov. 14.

MASON, OHIO.—A well is being drilled here with a view to constructing a water-works system. If sufficient water is found bonds to the amount of $16,000 will be issued for the system. R. W. Guthermuth is City Clk.

SANDUSKY, OHIO.—The Board of Public Service on Nov. 25 awarded the contract for 2,000 ft. of trenching for water mains on West Monroe St. to AUGUST ZIELKE, at 11¼ cts. per ft. The work will be commenced at once. A. J. Stoll is Pres. Bd.

GRAND RAPIDS, MICH.—The contract for laying a water main across the Grand River at Coldbrook St. was awarded on Nov. 27 by the Board of Public Works to J. P. RUSCHH, Grand Rapids, at $6,475. Other bidders were: Peninsular Construction Co., $9,620; G. W. Bunker, $7,996. Samuel A. Freshney is Secy. Bd.

*YORKVILLE, ILL.—We are officially advised that bids were received as follows on Dec. 1 by the Village Board for constructing a concrete reservoir, complete: RICH & CARLESON, Fort Dearborn Bldg., Chicago, Ill., $5,968 (awarded contract); H. G. Goetz, Oak Park, Ill., $6,900; T. H. Ingelhart, Morgan Park, Ill., $7,708. H. D. Hallett is Engr., Aurora, Ill.

RICHLAND CENTER, WIS.—Bids will be received about Jan. 1 for improvements to the water-works here. Estimated cost, $7,000. W. G. Kirchoffer is Engr., Madison, Wis.

DAVENPORT, IOWA.—Plans are being prepared for the construction of a filtering plant on 24th St., with 6,000,000 gallons capacity. Estimated cost, $75,000. Thomas Murray is City Engr.

EAST GRAND FORKS, MINN.—Bids are asked until 3 p. m., Dec. 14, by C. P. Zimmerman, City Clk., for constructing a pumping station and a mechanical gravity filter plant. Loweth & Wolff are Engrs., St. Paul, Minn.

ELLIS, KAN.—The citizens have voted to issue bonds for about $40,000 for the construction of water-works and an electric light plant. W. K. Palmer & Co., Dwight Bldg., Kansas City, Mo., are Engrs.

FORT ROBINSON, NEB.—The contract for constructing extensions to the water and sewer system at Fort Robinson, has been awarded to J. J. HANNIGHAN, of Omaha, Neb., at $12,538.

JOLIET, MONT.—The town has decided to construct water-works and a power plant. Estimated cost, $50,000.

MACON, MO.—The citizens on Nov. 27 voted to issue $18,400 of bonds for water-works and an electric light plant. Edward S. Bennett, of Macon, is Engr.

DE QUEEN, ARK.—The city will construct a water-works system for which bonds will be issued. The plant will include a 50,000-gallon steel tank on a 100-ft. tower and 50,000-gallon reservoir located at artesian wells, from which supply will be secured. Estimated cost, $25,000. W. K. Palmer Co., Engrs., Dwight Bldg., Kansas City, Mo.

SEYMOUR, TEX.—The O'Neil Engineering Co., 843 Wilson Bldg., Dallas, Tex., is preparing plans for a water-works system here. Estimated cost, approximately $30,000; material to be purchased by O'Neil Engineering Co.

CHILDRESS, TEX.—The citizens on Nov. 24 voted to issue bonds for the construction of water-works.

JEFFERSON, TEX.—The city has voted $10,000 of bonds for the extension of water-works.

ELGIN, TEX.—The city contemplates the construction of a water-works system.

FORT MCINTOSH (Laredo post-office), TEX.—Joseph Netzer, of Laredo, Tex., has submitted the lowest bid for the construction of a purification plant here, at $4,390.

CHEROKEE, OKLA.—The city has voted $25,000 of bonds for the construction of water-works. The contract has been awarded to CHARLES A. TAPPAN, Oklahoma City, Okla.

AFTON, OKLA.—We are officially advised that the following contracts were awarded on Nov. 19 and 20, for water-works equipment, machinery and deep well: Deep well, to W. S. WAUGH, Galena, Kan.; c.-i. pipe, to AMERICAN CAST IRON PIPE & FOUNDRY Co., Birmingham, Ala.; tower and tank, to CHICAGO BRIDGE & IRON CO., 105th and Throop Sts., Chicago, Ill.; engines, to ENGLISH IRON WORKS CO., 408 West Fifth St., Kansas City, Mo.; generator, exciter and switchboard, to WESTINGHOUSE ELECTRIC CO., Kansas City, Mo.; air-lift equipment, to REEVES & SKINNER, Chemical Bldg., St. Louis, Mo.; motor-driven pump, to REEVES & SKINNER; steam specialties, to ENGLISH IRON WORKS, Kansas City, Mo.; pipe, valves and fittings, to ENGLISH IRON WORKS, Kansas City, Mo.; boilers, to KANSAS CITY ENGINEERING CO., Kansas City, Mo. The W. K. Balmer Co. are Engrs., Dwight Bldg., Kansas City, Mo.

CHEYENNE, WYO.—Bids were opened as follows on Nov. 30 by the city for the construction of the Crystal Lake reservoir: R. W. Bradley & Co., Cheyenne, $45,198; Strange & Armstrong, Salt Lake City, Utah, $46,903; R. N. Bardsen & Co., Butte, Mont., $60,021; Gaffy & Keefe, of Denver, Colo. (not totaled); Morrison Construction Co., $53,400.

Bids were also opened as follows for the construction of a masonry dam to contain approximately 7,500 cu. yds. of concrete, 3,847 cu. yds. earth fill and 348 cu. yds. stone riprap; also 547 cu. yds. of loose rock and 1,643 cu. yds. of solid rock removed: Strange & Armstrong, $33,750; R. W. Bradley & Co., $33,975. C. C. Carlisle is City Engr.

*LAS ANIMAS, COLO.—The Board of Trustees have awarded the contract to MARSHALL BROS., Las Animas, at $48,673, for improving of the water-works system, including a new pumping plant and equipment, steel tank or standpipe, and extension and addition to present mains, approximating 23,000 lin. ft. of c.-i. pipe. The W. K. Palmer Co., Dwight Bldg., are Engrs.

SUNNYSIDE, WASH.—The Trustees of the Sunnyside Water Users' Association awarded the contract for the construction of the laterals of the Mabton division of the Sunnyside water project to MEEKS & CARPENTER of Mabton, at 15 cts. per cu. yd. for common dirt excavation. A portion of the Prosser extension system of laterals was let to L. H. BOYLES at 17 cts. per cu. yd.

*WENATCHEE, WASH.—Bids, exclusive of pumping plant, were opened as follows on Nov. 24 by the City Council for extensions and additions to the water-works: Ball & McNerney, Wenatchee, $29,075; I. J. Bailey & Co., Wenatchee, $30,714; Elliott Bay Iron Works, Seattle, $31,657; Isle & Knight, Spokane, $32,477; W. D. Lovell & Co., Minneapolis, Minn., $32,751; W. F. McMahon & Co., Seattle, $34,754; H. J. Kimmel, Wenatchee, $37,181.

SACRAMENTO, CAL.—The South Feather Land & Water Co., with D. S. Wasserman, J. S. Gattman, S. F. McNear, L. S. Hinsdale and L. G. Siller, all of Sacramento, as directors, has filed articles of incorporation with the County Clerk. The purpose of the company is to acquire water rights for the sale and distribution of water for irrigation purposes and the development of water power and electricity in the counties of Butte, Plumas and Yuba. Capital stock, $250,000.

LOS ANGELES, CAL.—We are officially advised that bids were received as follows on Nov. 30 by the Board of Public Works for the construction of the Antelope division of the Los Angeles viaduct: Henningsen Construction Co., $982,434; P. A. Howard, 212 Frost Bldg., Los Angeles, $529,009; A. C. St. John, H. W. Hellman Bldg., Los Angeles, $383,995; A. H. Calkins, $596,741. Engineer's estimate, $457,350. Contract was awarded on Dec. 2 to P. A. HOWARD. The contract involves the excavation of eleven miles of aqueduct, which is to be lined with concrete.

VICTORIA, B. C.—All bids received for the pumps for the high-pressure system have been rejected because they did not conform to the specifications. New bids will be asked. W. W. Northcote is Purchasing Agt.

SEWERAGE.

(denotes that this work is advertised in Engineering News.)*

WOONSOCKET, R. I.—The Sewer Commissioners have awarded the contract to the CUMBERLAND CONSTRUCTION CO., of Providence, R. I., for constructing sewers in Vernon and Bennett Sts.

NIAGARA FALLS, N. Y.—The Board of Estimate on Nov. 23 authorized an issue of $70,000 bonds for the extension of the tunnel trunk sewer from Sugar St. to the Echota factory district. Willett W. Read is City Engr.

WATERTOWN, N. Y.—Bids will probably soon be asked for the construction of the proposed sewerage system in the Third and Fourth Wards. Estimated cost, about $80,000. Henry E. Baker is City Engr.

BROOKLYN, N. Y.—Bids were received on Dec. 2 as follows by Bird S. Coler, Boro. Pres., for furnishing all the labor and material required for constructing a sewer in East 98th St., from East New York Ave. to Hegeman Ave., with outlet sewers in East 98th St., etc., etc., etc., etc., Section 3: John J. Creen, 73⅝%; James Kelly, 94½%; Joseph Boyce, 70%; James L. Carey & Son, 78 47-100%; John T. Cogan, 97%; Rogers & Hoggerty, 82%; King, Rice & Gainer, 79%; Sigretto & Manino, 85%. Engineer's estimate, $206,640.

Bids were received on Dec. 2 for furnishing all the labor and material required for constructing sewer in Central Ave., from Moffatt St. to Chauncey St.: Leo E. Kelly, 651 Belmont Ave., 89⅞%; Murphy Bros., 96%; Joseph Tarimino, 90%; Richards T. Jennings, 104%.

NEW YORK, N. Y.—Bids were received as follows on Dec. 1 by Louis F. Haffen, Pres. Boro. of the Bronx, for constructing a sewer and appurtenances in Nelson Ave., between Boscobel Ave. and Featherbed Lane: Edwin M. Lynch, $8,243; Briggs & McLaughlin, $9,526; Joseph Burns, $9,236; Hanover Contracting Co., $8,681; J. M. Stanton, $10,808; Merrill & Sheil, $10,144.

Bids were also received for constructing a sewer and appurtenances in Jerome Avenue, between East 208th St. and summit north of Gun Hill Road: P. F. Brennan, $9,168; Briggs & McLaughlin, $10,600; Wakefield Construction Co., $10,612; Voorhees & Sullivan, $9,903; McDonald & Barry, $10,509.

NEW YORK, N. Y.—Bids were received on Dec. 1 by Louis F. Haffen, Pres. Boro. of the Bronx, for constructing sewers and appurtenances in Mosholu Parkway, between Mosholu Parkway South, near Jerome Ave. and Mosholu Parkway North, at the intersection of Jerome Ave. and Mosholu Parkway North; and in Jerome Ave., between Mosholu Parkway North and East 208th St.; and in Mosholu Parkway North, between Jerome Ave. and Gates Place: Knox Place, between Mosholu Parkway North and Gun Hill Road; Gates Place, between Mosholu Parkway North and Gun Hill Road: East 208th St., between Jerome Ave. and Woodlawn Road; East 210th St., between De Kalb Ave. and and Woodlawn Road: De Kalb Ave., between East 208th St. and Gun Hill Road: Kossuth Pl., between Mosholu Parkway North and De Kalb Ave.; Steuben Ave., between Mosholu Parkway North and Gun Hill Road; Van Cortlandt Ave., between Mosholu Parkway North and Rochambeau Ave.; Rochambeau Ave., between Van Cortlandt Ave. and Gun Hill road: McDonald & Barry, 183d St. and Tibbott Ave., $55,823; Hopper & Perrine, $104,132; Wakefield Construction Co., $86,887; Leahy Contracting Co., $80,075; P. F. Brennan, 244 Mount Hope Pl., $84,288; Jos. M. Stanton, 1341 Webster Ave., $77,583; Joseph Burns, 147 East 125th St., $87,092; Briggs & McLaughlin, 19 East 130th St., $90,869; O'Leary, Lyon & Flannigan, 245 East 202d St., $78,613. George M. Dunn, $84,648; John C. Rogers, $91,481.

Bids were also received for constructing sewers and appurtenances in Mosholu Ave., between Broadway and Von Humboldt Ave., at its intersection with West 254th St.: O'Leary & Flannigan, $26,099; Voorhees & Sullivan, $29,115; P. F. Brennan, 244 Mount Hope Pl., $30,901; Hanover Contracting Co., 215 West 125th St., $32,717; Joseph M. Stanton, 1341 Webster Ave., $32,461; Joseph Burns, $31,099; McDonald & Barry, $30,571; Briggs & McLaughlin, $28,306; O'Connor & McIntyre, $30,604; George M. Dunn, 737 East 171st St., $26,873.

NEW YORK, N. Y.—The following bids were received by John F. Ahearn, Pres. Boro. of Manhattan, on Dec. 7, for furnishing all labor and material required for alterations and improvement to sewer and appurtenances in 118th St., between Third and Lexington Aves.: Smith & Fitzgerald, $5,005; M. Marrome, $5,678; Thomas A. Reilly, $6,196; Eugene A. Blessing, $8,852; Bart Dunn, $5,843; New York Sewer Construction Co., $6,298; Galvin & Cantwell, $6,447; Edward Brennan, $6,565; Joseph Moore, $6,345.

The following bids were received at the same time for furnishing all the labor and material required for extension of sewer and appurtenances in 142d St., from and of present sewer to Harlem River: James Moore, $5,483; Joseph Burns, $5,483; Edward L. Brennan, $6,348; Bart Dunn, $6,682; Eugene A. Blessing, $6,238; Thomas A. Reilly, $7,204; Smith & Fitzgerald, $6,109; James G. Hurder, $6,808; New York Sewer Construction Co., $7,905; Alame Construction Co., $6,881.

BUFFALO, N. Y.—Bids were received on Nov. 28 by the Commissioner of Public Works for constructing a 30 and 27-in. brick and a 12 and 10-in. tile sewer in Weimer St., between Clinton and Griswold Sts., and in Griswold St., between Weimer and Weaver Sts., as follows: William Franklin, $5,100; John Miller, $5,516; Frederick J. Mumm, $5,988; George W. Moore, $6,200; Sojes & Fahning, $6,500. Francis G. Ward is Comr.

*RYE, N. Y.—The Board of Trustees on Dec. 2 awarded the contract to DAVID PEOPLES, Betz Bldg., Philadelphia, Pa., for the construction of the sewer system here, at $290,075. G. Everett Hill, 156 Fifth Ave., New York, is Engr.

FULTON, N. Y.—The Board of Public Works has awarded the contract to PIETRO MASSARI for the construction of storm sewers in West First St., Hannibal St. and Worth St., at $3,500.

MONTCLAIR, N. J.—The Town Council has passed resolutions providing for the construction of storm sewers in Walnut St. and Highland Ave., and for a drain on Mission Pl. K. Owen is City Engr.

GLENSIDE, PA.—Albright & Mebus, Consult. Engrs., Land Title Bldg., Philadelphia, Pa., are preparing plans for a sewage disposal plant at Glenside, for William T. R. Roberts & Son, Land Title Bldg., Philadelphia. Bids are asked after Jan. 1.

WILKINSBURG, PA.—Preese & Sperling, Boro. Engrs., have completed plans for the construction of a storm sewer system which have been forwarded to the State Board of Health for approval. Estimated cost, $200,000. John Gates, Jr., is Chn. Sewer Com.

BALTIMORE, MD.—Bids will be received until 11 a. m., Dec. 16, by the Board of Awards at the office of J. Sewall Thomas, City Register, for furnishing and placing approximately 165,000 cu. yds. of broken stone at the sewage disposal works on Back River, sanitary contract No. 36, and for constructing storm water drains, Contract No. 6, requiring 240 lin. ft. 114-in., 1,218 lin. ft. 96-in., 110 lin. ft. 42-in., 22 lin. ft. 36-in., 1,005 lin. ft. 24-in., 272 lin. ft. 18-in., 574 lin. ft. 15-in. drain, 515 lin. ft. inlet connections, 2,715 cu. yds. concrete, 1,526 lin. ft. underdrain, 4,000 cu. yds. embankment, 480 lin. ft. manholes and drop wells, 23 inlets. Peter Leary, Jr., is Chn. Bd. Sewerage Comrs. Estimated cost of the storm water drains, $50,000.

WASHINGTON, D. C.—The WARREN F. BRENIZER CONSTRUCTION CO., of Washington, has secured the contract for constructing a concrete sewer here, at $6,284. Bids were opened on Nov. 30.

WINCHESTER, VA.—The city is considering the construction of about eight miles of sewers, with disposal plant. N. W. Davis, Charlottesville, Va., has been engaged to prepare plans and specifications. Shirley Carter is Chn. Sewerage Comn.

ST. AUGUSTINE, FLA.—The city contemplates the construction of a sewerage system. Eugene Masters is Mayor.

BINGHAMTON (Memphis post-office), TENN.—The following bids were opened by the city on Nov. 25 for constructing a system of 6, 8, 10, 12 and 15-in. pipe sewers, with manholes and flush tanks: G. Jaeger, Rich Hill, Mo., $15,062; H. W. Brennon, Memphis, Tenn., $14,020; Conrad Walker, Brinkley, Ark., $11,789; J. A. Taylor, $18,857; W. E. Ayres, Memphis, $17,352; Pouncey Paving & Construction Co., Helena, Ark., $14,490; C. J. Wagner, Memphis, $14,693.

*LOUISVILLE, KY.—Bids are asked by the Commissioners of Sewerage until noon, Dec. 23, for the construction of a sewer known as the Barret Ave. sewer contract No. 17 of the Comprehensive System of Sewerage for the city.

Bids are asked until noon, Dec. 30, for the construction of sewers known as the Hoertz Ave. and Aubin Ave. sewers, contracts Nos. 18 and 19, of the above system. J. B. F. Breed is Ch. Engr.

HAMILTON, OHIO.—Bids will be received by the Board of Public Service until noon, Dec. 16, for the construction of sanitary and storm sewers in sundry streets. Christian Pabst is Secy. Bd.

TOLEDO, OHIO.—We are officially advised that the Board of Public Service, Reynold Voit, Secy., has awarded the contract to T. J. KELLEY, Toledo, for the construction of sewers Nos. 1051, 1054, 1056 and 1058. Bids were opened on Nov. 27.

WARREN, OHIO.—The Board of Public Service has selected Alex. Potter, New York, to prepare plans for the construction of sewers and a sewage disposal plant. Charles B. Selby is City Audr.

CLEVELAND, OHIO.—W. M. GRIBON and CHRISTIAN BURKHART have secured the contract for the construction of the Morgana Ave. sewer, at $30,000.

FORT WAYNE, IND.—Bids are asked by the Board of Public Works until Dec. 27 for the construction of a vitrified clay pipe sewer in the alley east of Short St. H. A. Beeker is City Clk.

INDIANAPOLIS, IND.—Bids were opened as follows by the Board of Public Works on Nov. 25 for the construction of a combination storm and sanitary sewer in Layman & Carey's Irvington Park addition, between Emerson Ave. and Wallace St.: Manley, O'Donnell & Co., $1.69 per lin. ft.; American Construction Co., $1.70; William Yates & Co., $1.72; Henry Maag, $1.74; R. F. Pickens, $1.79; Schauer & Roesinger, $1.80; Sheehan Construction Co., $1.82; John Jenkins, $1.87½. Cost, about $15,000. Blaine H. Miller is City Engr.

SHELBYVILLE, IND.—Bids will probably be called for in February on the first contracts for the sewerage system. Estimated cost, about $140,000. The Riggs & Sherman Co., of Toledo, Ohio, are Engrs. Noted on Nov. 26.

ARGO, IND.—Plans will be prepared by Percy Throyer, Consult. Engr., Plymouth, Ind., for 2,000 ft. of 24-in. pipe sewer, to be constructed here. D. L. Berlin is City Clk.

QUINCY, ILL.—The Board of Local Improvements on Nov. 26 recommended the construction of the proposed North End sanitary trunk sewer. Estimated cost, $54,000. F. L. Hancock is City Engr.

DULUTH, MINN.—Thomas F. McGilvary, City Engr., will prepare plans for the construction of a sanitary sewer to include 6,000 ft. of tile, 6 to 18-in., 13 manholes, c.-i. rings and covers in West Third St., from 34th to 39th Aves.

LEXINGTON, NEB.—The COOK CONSTRUCTION CO., of Des Moines, Iowa, has secured the contract for constructing 12 and 15-in. pipe sewers at 55 cts. and 70 cts. per lin. ft., manholes $8 per vertical ft. and concrete septic tank $3,000. Total cost, $13,097. Bids were opened on Nov. 27. H. O. Smith is City Engr.

BEAUMONT, TEX.—Bids will be received by J. G. Sutton, City Secy., until 10 a. m., Dec. 15, for the construction of approximately 1,055 lin. ft. of 12-in. vitrified pipe sewer in Magnolia Ave., between Elm and Caldwell Sts., and approximately 615 lin. ft. of 8-in. vitrified pipe sewer in Caldwell St.

*MUSKOGEE, OKLA.—Bids are asked by the city until Dec. 21, for the construction of storm sewers. Estimated cost, $250,000. L. B. Kinsey is City Engr.

CHEROKEE, OKLA.—The city has voted $40,000 of bonds for the construction of a sewer system here. The contract has been awarded to CHARLES A. TAPPAN, Oklahoma City, Okla. Frank A Lathrop, Cherokee, is City Engr.

LADYSMITH, B. C.—A complete sewerage system will be laid here. Plans have been prepared by E. Mohun, C. E.

GARBAGE DISPOSAL.

(denotes that this work is advertised in Engineering News.)*

*BOSTON, MASS.—Bids are asked by Guy C. Emerson, Supt. of Streets, until noon, Jan. 5, for the erection and operation on the property of the city at Fort Hill wharf, of a plant for the disposal by incineration of portions of the combustible waste, to be separated from city refuse, delivered at the plant. The approximate amounts of refuse to be treated, based on the collections for the present year, are as follows: Paper, 12,592 tons; mixed refuse (garbage, ashes and paper), 42,982 tons; mixed refuse (ashes and paper), 57,050 tons; dry-weather street-sweepings, 2,500 tons.

FORT SLOCUM (New Rochelle post-office), N. Y.—Bids are asked until 10 a. m., Jan. 6, by the Constructing Quartermaster for constructing a garbage crematory at this post.

PHILADELPHIA, PA.—Bids were opened on Dec. 2 by George R. Stearns, Dir. Pub. Wks., for cleaning the streets and removing ashes for next year. The contract has been awarded to EDWIN H. VARE, Betz Bldg., Philadelphia, at $1,199,000.

The PENN REDUCTION CO., 14 South Broad St., Philadelphia, secured the contract for removing garbage next year at $488,988. This firm was the only bidder.

COLUMBUS, OHIO.—The Board of Public Service has awarded three contracts for building portions of the garbage disposal plant as follows: C. O. BARTLETT & SNOW CO., 1040 French St., N. W., Cleveland, Ohio, for dryers at $12,650; the KUTZTOWN CO., Philadelphia, Pa., for digestors, grease removers, at $38,000 and $94,000 (two contracts).

STREETS AND ROADS.

(denotes that this work is advertised in Engineering News.)*

HARTFORD, CONN.—Maps for State road work have been received in the office of the State Highway Commissioner as follows: From C. H. Olmsted, Engr., three sections in town of Manchester, aggregating 11,700 ft. on Oakland, Hillard and Charter Oak Sts.; from E. B. Harger, Engr., three sections on Waterbury Road, in town of Middlebury, aggregating 8,300 ft.; from T. M. Russell, Engr., 18,700 ft. on Middletown and Meriden Turnpike, partly in town of Middletown and partly in town of Middlefield; from John E. Egan, Engr., 7,200 ft. on the main road from Thompsonville to Stafford, through Somers; from John S. Dickinson, Engrs., 10,700 ft. on the Ferry Road in Old Saybrook.

NEW YORK, N. Y.—Bids are asked until noon, Dec. 15, by Allen N. Spooner, Comr. of Docks, for furnishing all the labor and materials required for repairing asphalt pavement on North and East Rivers, together with all work incidental thereto.

NEW YORK, N. Y.—Bids were received on Dec. 3 by Louis F. Haffen, Pres. Boro. of The Bronx, for furnishing all labor and materials for reconstructing the roadway of the Eastern Boulevard in Pelham Bay Park, including surfacing with asphaltic mixture, from a point 400 ft. north of the Split Rock Road, to the northerly approach of the new bridge over Eastchester Bay from the southerly approach of said bridge to the southerly boundary of Pelham Bay Park, Borough of The Bronx, as follows: J. A. Boyce, $1.38 per yd.; Phoenix Construction Co., 41 Park Row, New York, $1.59; Standard Asphalt & Rubber Co., 115 Broadway, New York, $1.42; Imperial Road Co., $1.46; Uvalde Asphalt Paving Co., 1 Broadway, New York, $2.10; Sicilian Asphalt Paving Co., $1.49; Thomas M. Hart, $1.54; Warren Asphalt Paving Co., $1.43.

BROOKLYN, N. Y.—Bids are asked by Bird S. Coler, Boro. Pres., until 11 a. m., Dec. 23, for regulating, paving and repairing with asphalt, asphalt block and granite on a concrete foundation the roadways of various streets; also for curbing and laying sidewalks on several streets.

*HILLSDALE, N. J.—We are officially advised that H. B. SPROUL, Peekskill, N. Y., was awarded the contract on Nov. 25 by the Township Committee for macadamizing and grading Yesler Way, Piermont, Fairview, Magnolia, Summit and Washington Aves. and Lawrence St., a total distance of 2,656 miles, and also for grading and macadamizing 5.33 miles of streets here, at $18,506. H. G. Hering, Jr., is Township Engr.

PITTSBURG, PA.—Bids will be received until 10 a. m., Dec. 10, by the Department of Public Works, Alex. B. Shepherd, Acting Dir., for grading, curbing and paving with sheet asphalt portions of Seibert, Broad, Park View, Ward, Jancey and Borland Sts., with vitrified brick on Post Alley; repaving with sheet asphalt on Pennsylvania, Fifth and Western Aves.

Bids will be received until noon, Dec. 23, by F. P. Booth, County Comptroller, Pittsburg, for improving Troy Hill extension, No. 2 road, a distance of 2-3 of a mile. George T. Barnsley is Ch. Road Engr., Court-House, Pittsburg.

YORK, PA.—The BARBER ASPHALT PAVING CO., Land Title Bldg., Philadelphia, has secured the contract for paving with sheet asphalt a portion of Market St., at $1.97 per sq. yd.

McKEESPORT, PA.—HENRY BOLAR has been awarded the contract for the improvement of several streets in the Tenth Ward.

HAGERSTOWN, MD.—The Washington County Commissioners contemplate a further expenditure of $20,000 for road improvements.

SALISBURY, MD.—Bids are asked by the County Commissioners until noon, Dec. 15, for improving the Athol Road. H. M. Clark is County Road Engr.

ROANOKE, VA.—Bids are asked by R. H. Wills, City Clk., until noon, Dec. 23, for paving Luck Ave., from Henry to Nelson Sts., and for curb and gutter on both sides of a portion of Gilmer Ave. N. W. W. B. Bates is City Engr.

FORT MYER, VA.—Bids are asked by Capt. B. B. Hyer, Constructing Q. M., U. S. A., until 11 a. m., Dec. 17, for the reconstruction of paving and gutters around artillery stables.

SALISBURY, N. C.—The War Department has awarded the contract to THOMAS A. BARRY & CO., Richmond, Va., for the construction of a driveway for the Government from South Main St. to the National Cemetery, $20,000 having been appropriated for the work.

ORANGEBURG, S. C.—We are officially advised that bids were received as follows on Nov. 19 by the city for street improvements: SOUTHERN PAVING & CONSTRUCTION CO., Chattanooga, Tenn., $21,165 (awarded contract); Georgia Engineering Co., Augusta, Ga., $21,452; Bowe & Page, Augusta, Ga., $22,246. Engineer's estimate, $21,637. The work includes 8,700 sq. yds. vitrified brick paving on a 5-in. concrete foundation, 1,730 ft. of 20, 18, 15, 12 and 10-in. drains, manholes, inlets, etc. Edward Hawes is City Engr.

DUBLIN, GA.—The GEORGIA ENGINEERING CO., of Augusta, Ga., has secured the contract for paving with brick the business section of the city, at about $50,000.

NEW ORLEANS, LA.—The City Council on Nov. 25 awarded to the BARBER ASPHALT PAVING CO., 205 Chartiers St., New Orleans, the contract for paving with asphalt Broadway, Hurst and Atlanta Sts., and to W. J. COMMERFORD the contract for paving with vitrified brick Howard St., and to C. HYLAND the contract for repaving with granite block Magazine St., from Julia to St. Joseph Sts.

The following bids have been received for paving General Taylor St. with chert: Grasser Contraction Co., Hennen Bldg., New Orleans, $33,948; W. J. Comerford, $21,088; Elta Contracting Co., $21,025.

OPELOUSAS, LA.—Bids will be received until Dec. 22 by M. Halphen, Mayor, for the construction of approximately 35,000 sq. ft. of cement sidewalks and 7,000 lin. ft. brick curbing. J. J. Naff is Acting City Engr.

CHATTANOOGA, TENN.—E. P. Norris, Duncan Ave. and Spruce St., Chattanooga, has submitted the lowest bid to the Board Public Works, at about $23,000, for the construction of about 4,100 ft. of chert roadway, etc., on East Eleventh St. H. F. Van Dusen is Chn. Bd.

ZANESVILLE, OHIO.—Bids will be received until Dec. 18 by the Board of Public Service, J. T. Hahn, Clk., for furnishing material, grading, curbing and paving a portion of McIntire Ave.

AKRON, OHIO.—The Board of Public Works on Nov. 23 opened bids as follows for paving: Russell Ave., D. O'Mara, $7,230; McAlonan Bros., $8,085; P. T. McCourt, $6,468; Doll & Lynn, $6,762; E. McShaffrey & Son, 173 South Forge St., $6,709; Hunt & Wigley, $7,718; James Wildes, 44 South College St., $6,615.

CINCINNATI, OHIO.—We are officially advised that CLIFFORD ROBINSON, of Hamilton, Ohio, was awarded the contract on Nov. 27 by the Board of County Commissioners for repairing Springfield Pike in Springfield Township.

The County Commissioners have awarded the contract for repairing the Cleves Road to NUGENT & HINES, at $13,702.

CLEVELAND, OHIO.—Bids are asked until noon, Dec. 17, by A. R. Callow, Secy. Bd. Pub. Ser., for grading, draining, curbing, paving with brick and improving various thoroughfares.

ANDERSON, IND.—Bids are asked until 10 a. m., Dec. 15, by Wm. T. Richards, County Audr., for constructing 25 gravel roads.

VALPARAISO, IND.—McGILLICUDY & LEICESTER have been awarded the contract by the city for laying 16,000 sq. yds. brick pavement on a 6-in. stone foundation, 2-in. sand cushion, at $1.38 per sq. yd.; also 1,000 lin. ft. concrete curbing, at 44 cts. Other bidders were: H. C. Finley, $1.42; Moellering Construction Co., $1.44; Conover & Taber, $1.42½; W. B. Hutchinson, Jr., $1.46; Fred Hoffman, $1.48.

C. W. DICKOVER has secured the contract for laying 10,000 sq. ft. of cement sidewalk at 10½ cts. per sq. ft. Charles D. Jones is City Clk.

INDIANAPOLIS, IND.—The Board of Public Works has ordered plans prepared for paving Kentucky Ave., from White River Bridge to Harding St., with brick and for paving Stockyards Ave. with brick. Blaine H. Miller is City Engr.

NOBLESVILLE, IND.—Bids are asked by the Commissioners of Hamilton County until Dec. 28 for the construction of the county line gravel road. W. T. Richards is County Audr.

GRIFFITH, IND.—Bids are asked by the Board of Trustees until 7.30 p .m., Jan. 2, for the construction of a cement sidewalk on the east side of a portion of Wood Ave. M. J. Bieriger is Town Clk.

CHICAGO, ILL.—A boulevard and bridge to connect the north and south park and boulevard systems is being agitated. Several plans have been suggested with a view of changing the present connection by way of narrow and crowded streets and an old and inconvenient bridge to a broad thoroughfare and a new bridge. In the plan prepared by I. H. Burnham and indorsed by the Commercial Club, the boulevard would be about 246 ft. wide south of the river and 216 ft. wide on the north side, with a double-deck connecting bridge of 90 ft. The adjacent buildings would open directly upon the boulevard, and would also have access to the lower street level. Inclined roadways within the boulevard would afford connection with the cross streets. The grades would be 2.7% for one block at the south end (beginning at Randolph St.) and 3.3% for one block at the north end of the boulevard (ending at Chicago Ave.). The approaches to the lower deck of the bridge would be 2½%, as compared with 5% for the present Rush St. bridge which now has to carry both team and carriage traffic on one deck. In same plans, it has been proposed to raise only the middle portion of the boulevard, but the objection is that this would leave a dark and narrow side street on each side, and the buildings would open upon these streets instead of upon the boulevard.

MANITOWOC, WIS.—Bids will be received until Dec. 15 by the Board of Public Works for improving a portion of 24th St. Arthur Reichert is City Clk.

INDEPENDENCE, IOWA.—Bids will be received until Dec. 14 by Rufus Brewer, City Clk., for furnishing material and paving with vitrified brick a portion of Second Ave., requiring about 11,438 sq. yds. and curbing 3,230 lin. ft.

KANSAS CITY, MO.—The Board of Public Works has adopted a resolution providing for the paving of Union Ave. with creosoted block.

TEXARKANA, ARK.—Precinct No. 1 has voted $250,000 of bonds for road construction, $75,000 of the sum to be expended on streets in the suburbs of the city and the remainder in country districts.

BROWNWOOD, TEX.—The city has voted $10,000 of bonds for street improvements.

ORANGE, TEX.—The City Council on Nov. 25 awarded to T. W. ELLIS, of Orange, the contract for cement curbing on a portion of Main St.

CARRIZO SPRINGS, TEX.—Dimmit County has voted $30,000 of bonds for road improvements.

MUSKOGEE, OKLA.—We are officially advised that contracts were awarded on Nov. 16 and 18 for sheet asphalt paving aggregating $300,000. Contracts were secured by the PARKER-WASHINGTON CO., 4500 Duncan Ave., St. Louis, Mo. for about one-half the work at $1.79 per sq. yd. for Bermudez asphalt. P. J. McNERNEY secured the major part of the other half at $1.89 per sq. yd. for Texico asphalt.

The CLEVELAND TRINIDAD PAVING CO., Cleveland, Ohio, secured contracts at $2.03 per sq. yd. for Trinidad asphalt and the HEMON CONSTRUCTION CO., Fullerton Bldg., St. Louis, Mo., the contract for 25,000 sq. yds. of paving at $1.80 for Trinidad asphalt. L. B. Kinsey is City Engr.

SULPHUR, OKLA.—The Council has awarded the contract for paving in paving district No. 1 to the SHELBY-DOWNARD ASPHALT CO., of Ardmore, Okla., at about $24,000.

SEATTLE, WASH.—R. H. Thomson, City Engr., has reported upon the estimated cost of local improvement work as follows: Crescent Drive, from East Galer St. to 24th Ave. North, paving with asphalt, $25,000; Sixth Ave., from Union St. to Madison St., paving with vitrified brick, $25,000; Market St., from 20th Ave. W. to 14th Ave. N. W., planking, $7,800; Sixth Ave. West, from West Galer St. to West Comstock St., concrete sidewalks, $5,500; Jackson St., from 23d Ave. South to 31st Ave. South, paving with asphalt, $195,000.

ANACORTES, WASH.—CHAS. E. LIND, of Bellingham, Wash., has been awarded the contract for improving Commercial Ave., at $4,350.

SALT LAKE CITY, UTAH.—We are officially advised that bids were received as follows on Nov. 27 by the Board of Public Works for the construction of sidewalk extension No. 141: J. D. Hanley, Salt Lake City, $6,164; DAVIS & HEUSER, Salt Lake City, $5,034 (awarded contract); S. Birch & Sons Construction Co., Salt Lake City, $6,623.81.

COCHRANE, ONT.—The Temiskaming & Northern Ontario Railway Commission contemplates expending $15,000 this winter in clearing and grading the streets of this city.

BRAMPTON, ONT.—The contract for the construction of a wall and sidewalk on Main St. has been awarded to E. W. MITCHELL at $3,910.

WINNIPEG, MAN.—DOBSON & JACKSON have been awarded the contract for laying a block pavement on Sargeant Ave., from Arlington to Ern St., at $18,131.

MANUFACTURING PLANTS.

(denotes that this work is advertised in Engineering News.)*

NEW MARKET, N. H.—The New Market Mfg. Co. has decided to build a 3-story mill in the spring. Plans for the proposed mill are under way. The building will be located in rear of No. 8 mill on the banks of Lamprey River.

The Amoskeag Corporation, with mills in this city, is considering an increase of its gingham manufacturing plant here. The new building will be erected on the west side of the Merrimac River, and 3,500 or more operatives will be employed in addition to the force of 13,000 now at work. This will increase the production of the Amoskeag plant 25%.

SPRINGFIELD, MASS.—The H. WALES LINES CO., of Meriden, Conn., has been awarded the contract for the foundation work for the new factory building which the United States Envelope Co. is to erect on Cypress St. in Springfield. The plans call for a 5-story structure, 100 × 265 ft., with an ell, 65 × 80 ft. Samuel M. Green, Holyoke, Mass., is Arch.

THOMPSONVILLE, CONN.—We are officially advised that estimates are being taken for the construction of a 3-story fireproof brick factory, 50 × 150 ft., to cost $25,000. The equipment will cost $30,000. Isaac Allen, Jr., Hartford, Conn., is Arch.

NORWICH, CONN.—The Totokett Mfg. Co. is planning extensive additions to the plant. One feature of the plans calls for running the main mill, 50 × 250 ft., up an additional story. An additional storehouse of brick, 40 × 80 ft., is being built. The company is installing 800 Whiting looms, replacing old ones. The improvements which have been planned or already begun will involve an expenditure of about $100,000.

NEW YORK, N. Y.—The New York Breweries Co., Ltd., 441 West 25th St., has had plans prepared by C. F. Hebbinger & Co., Archs., 1140 Columbus Ave., Boston, Mass., for a 6-story brick and stone storage house, 52 × 98.9 ft. Cost, $80,000.

SCHENECTADY, N. Y.—The Mica Insulator Co. will erect a 4-story reinforced-concrete factory building to cost $130,000, the plans for which were drawn by W. L. Stoddard, Arch., 33 East 17th St., New York.

BUFFALO, N. Y.—We are officially advised that the Bergman Tool Co., 495 Ashland Ave., will erect a 3-story reinforced-concrete factory building, 42 × 170 ft., at Niagara St. and Forest Ave., at once. The contract will be let by S. Bergman, Pres., 102 Seneca St., about Dec. 20. Estimates are being received. C. D. Janson is Arch.

Preliminary work was begun this morning by DARK & CO. on the foundations for the blast furnaces to be erected by M. A. Hanna & Co., of Cleveland, on the Niagara frontier. The Hanna interests will put up a $3,000,000 plant, which will employ 700 men. Noted fully on Oct. 22.

BUFFALO, N. Y.—The Webster Citizens Ice Co. will build an ice manufacturing plant at 16-22 Mechanic St. It will have one story and will be of brick and steel construction.

JOHNSTOWN, N. Y.—Hallock & Stewart, glove manufacturers, will build a 4-story factory of brick, mill construction. P. M. Simmons, Arch., is preparing plans and will superintend the general construction. Work will be commenced about March 1.

ROME, N. Y.—The Spargo Wire Cloth Co., recently incorporated, is having plans prepared for a factory building, 100 × 200 ft., of steel and concrete, which it will erect at East Rome. James A. Spargo, Pres.

GLOVERSVILLE, N. Y.—The Wertheimer Glove Co., of Johnstown, N. Y., will build a 2-story factory here, 40 × 100 ft., of concrete and brick construction. Plans are being prepared and bids will be received by the owners.

WHITESBORO, N. Y.—The Alliance Knitting Mill has let a contract to D. HAYNES & SON, for the erection of a fireproof storehouse, 52 × 190 ft. The building will be located east of the mill. Work is to be begun immediately and the structure will be completed in January.

SYRACUSE, N. Y.—The Onondaga Litholite Co., H. P. Warner, Pres., having sold its present plant on the Erie Canal at Northwest and Tracy Sts., will build a new plant. A factory building, 50 × 250 ft., of concrete with steel truss roof, and a pattern shop and power building, 50 × 75 ft., two stories, of concrete construction, will be erected Plans have been prepared and bids will be received by owners at once.

The Oak Knitting Co. will build a 2-story brick factory, 35 × 70 ft., on Division St. E. A. Howard, Arch., has prepared plans and will receive bids at once.

The Syracuse Cold Storage Co., H. K. Chadwick, Pres., will build a cold storage plant at North West St. and the Erie Canal. The main building will be seven stories in height, 84 × 85 ft., steel frame and brick construction, fireproof, with a 1-story power building of brick and steel construction. W. C. Jarvis, Consult. Engr., 126 West 11th St., Indianapolis, Ind., is preparing plans and bids will be called for by the owners about Dec. 20.

TRENTON, N. J.—The management of the Princeton Worsted Mills Co., at Trenton, is preparing plans for a $20,000 addition to its plant. Another addition, to cost $3,000, has been started.

BALTIMORE, MD.—We are officially advised that a brick bottling plant of steel construction will be erected at the corner of Toone and Third Sts., Canton, by the George Ginther, Jr., Brewing Co. Otto G. Simonson, Arch., American Bldg., has prepared the plans. The building will be 40 × 75 ft., and two stories high. The following contracts have been let: Building, HENRY SMITH & SON, Mount Royal Ave. and Lanvale St.; equipment, BARRY-WEHMILLER MACHINERY CO., 21st and Walnut Sts., St. Louis, Mo. The building will cost $16,000; equipment, $20,000.

SOUTH BOSTON, VA.—The Century Knitting Mill, recently incorporated, will install machinery for manufacturing, dyeing and finishing hosiery, the initial equipment to cost $25,000. It will manufacture paper boxes for packing, and will occupy a building now being erected by the Century Cotton Mills, which will supply the knitting yarns. Electricity will be the motive power. F. A. Lukin is Pres. of both the companies mentioned.

GREENSBORO, N. C.—The management of the Revolution Cotton Mills at Greensboro announces its intention to erect a bleachery at once to cost about $40,000.

LEXINGTON, N. C.—It is stated that the management of the Yadkin Knitting Mills will arrange for the rebuilding and reequipment of that plant, which was destroyed by fire last spring. The company is capitalized at $21,000. Its burned mill had an equipment of 40 knitting machines, etc., producing womens cotton seamless hosiery.

COLUMBIA, ALA.—A. D. Wood, of Columbia, Ala., will expend $30,000 for the erection of the buildings for his cotton mill. The main structure will be two stories high, 80 × 230 ft. with a basement for the electric power plant. A dam to develop 1,000 HP. is being constructed. Probably 5,000 spindles and 150 looms will be installed for manufacturing shirting and sheeting.

BATON ROUGE, LA.—J. W. Thompson has started plans for rebuilding his sand and gravel plant at Profit Island, above Baton Rouge, which was destroyed by fire Nov. 17, entailing a loss of about $50,000.

SPRINGFIELD, TENN.—The Springfield Woolen Mills Co., of Springfield, Tenn., has decided on an increase of capital stock from $50,000 to $100,000 and enlargements to the present plant of 2,000 spindles and 32 looms. Arrangements have been made for the erection of an additional building, which will be 117 × 87 ft., to accommodate new machinery. The latter will include twelve broad looms, one set cards, fitting, pulleys, belting, steam-heating apparatus, etc., for part of which the contracts have been awarded. The new building will be of brick mill construction.

NOBLESVILLE, IND.—C. [illegible] Y is Pres. of a recently organized company to build a canning factory at Sheridan, Ind. Plans will be in order soon.

ANDERSON, IND.—At a [illegible] meeting of the Board of Directors of [illegible] tion Mfg. Co. in this city it is stated [illegible] was decided to increase the plant [illegible] city by building two large two-story [illegible] buildings. The company recently increased its capital to $500,000. When the new [illegible] tings are completed the plant will employ about 1,000 men. Former Governor W. [illegible] Darbin is Vice-Pres. Estimated cost, $1[illegible]

SHERIDAN, IND.—Arza Sn[illegible] announces that he will ask for bids for [illegible] rection of a large elevator on the site of [illegible] building recently destroyed by fire.

FORT WAYNE, IND.—The [illegible] Ice Co., R. J. Spencer, Pres., has been [illegible] corporated and will ask for bids soon for [illegible] construction of an artificial ice plant on Creely and Jackson Sts. Estimated cost, $[illegible].

BLOOMINGTON, IND.—The [illegible] Chicago, Indianapolis & Louisville Ry. Co., Chicago, has ordered plans for the erection of a big round house in this city. W. A. Wallace is Ch. Engr., Chicago.

STEVENS POINT, WIS.—The [illegible]ster Mfg. Co. has engaged C. F. Ringer & Co., 106 Mason St., Milwaukee, Mill Archs., to prepare plans and specifications for a factory building to cost $35,000.

ST. LOUIS, MO.—We are officially advised that the Champion Shoe Machinery Co., Channing and Franklin Aves., St. Louis, will erect on the north side of Forest Park Boulevard, west of Spring Ave., a plant that will have four times the capacity of its present factory at Channing and Franklin Aves. The structure will be concrete and will have a ground area of 170 × 182 ft. It will have two stories. The plans are almost completed, and bids are being received. The work of excavating will begin this week. J. H. Dobyne is Pres. The site for the factory is in the new manufacturing district and close to railroads. The building will cost $25,000; equipment, $25,000. William Watson is Arch.

The Brown Shoe Co. will build a large addition to its factory at No. 1711 Lucas Ave. The addition will cost approximately $50,000. It will be five stories high, 55 × 155 ft., brick and steel construction and fireproof throughout. A. B. Groves, 314 North Fourth St., prepared the plans and specifications and will supervise construction. MURCH BROS. CONSTRUCTION CO., Odd Fellows' Bldg., have the contract.

CHEHALIS, WASH.—The Chehalis Furniture Mfg. Co., of Chehalis, Wash., has let a contract to the MINNEAPOLIS STEEL & MACHINERY CO., 29th and Minnehaha Sts., Minneapolis, for an 18 × 36-ft. heavy duty Twin City Corliss engine and feed water heater.

SPOKANE, WASH.—The Washington Mill & Grain Co. will build a plant on site recently secured. Size and cost of the plant has not been determined. J. K. Smith is Mgr.

SALT LAKE CITY, UTAH.—The Salt Lake City "Herald" states that announcement has been made by the Inland Crystal Salt Co. that plans have been accepted for its new salt factory to be erected at Saltair to replace the salt factory which was destroyed by fire. The salt factory will be three stories high and 120 × 40 ft. The basement and foundations will be of concrete, reinforced by old railroad steel. The building above ground will be constructed of heavy, slow-burning fir timber and the roof will be shingled with slate. The plans have been drawn by J. K. Miller and the building will be fireproof. Estimated cost, $100,000. N. C. Clayton is Mgr., News Bldg.

MISCELLANEOUS CONTRACTS.

U. S. RECLAMATION SERVICE.—Items regarding irrigation, canal projects, etc., will be found under Water Supply—Irrigation.

PRISON FENCE.—New York, N. Y.—See item under Buildings.

RETAINING WALL.—New York, N. Y.—See item under Buildings.

DITCH.—La Fayette, Ind.—Bids are asked until 2 p. m., Dec. 12, by A. G. Arnold, County Surv., for construction of the Michael Leyden et al. ditch.

DREDGING.—Wilmington, Del.—Bids are asked until Dec. 14 by the Trustees for dredging the municipal harbor channel from the turning basin to the foot of Canal St.

DITCH.—Anoka, Minn.—Bids will be received until Jan. 9 by A. A. Caswell, County Audr., for constructing Ditch No. 49, requiring 83,000 cu. yds. excavation. Estimated cost, $12,975.

CRANE.—Nelson, B. C.—The CANADIAN FAIRBANKS CO. has secured the contract for supplying the traveling crane for the municipal power-house. Price, $3,620, f. o. b., Bonnington.

SLUICE GATES.—Grand Rapids, Mich.—Bids are asked by the city until Dec. 17 for one 5-ft. circular and two 4-ft. rectangular sluice gates with operating stands. L. W. Anderson is City Engr.

DREDGING.—St. John, N. B.—Bids are asked until 4 p. m., Dec. 18, by Napoleon Tessier, Secy. Dept. Public Works, Ottawa, Ont., for dredging at York Point and Ballast Wharf, St. John Harbor.

HOSE.—Hartford, Conn.—Bids are asked by Board of Contract and Supply until 11 a. m., Dec. 21, for 2,000 ft. of 2½-in. heavy double knit jacket seamless rubber-lined hose, fitted with 3-in. and 2½-in. couplings.

CONTRACT PRICES.

[Where * precedes item under Contract Prices the work was advertised in Engineering News.]

*FILTERS.—Reading, Pa.—Bids were received by the Board of Water Commissions on Nov. 24, as follows, for building about 8,000 ft. of 60-in. reinforced conduit and appurtenances for raw water for Maiden Creek sand filters. Lincoln S. Ramsey is Secy. Bd. The bidders were: (A) David Peoples, Reading; (B) Jos. P. O'Reilly, Reading; (C) Nolan Bros., Reading; (D) H. E. Ahrens Co., Reading; (E) Standard Construction Co., Wilkes-Barre, Pa.; (F) Hawman Construction Co., Reading; (G) Thos. H. Riddle, Philadelphia; (H) Booth & Flinn, Ltd., Pittsburg; (I) P. Vinnow, Philadelphia; (J) King, Rice & Ganey, Weehawken, N. J.; (K) Geo. H. Meinholz, Reading; (L) Timothy J. O'Connell, Baltimore, Md.; (M) Fehr & O'Rourke, Reading; (N) S. W. CHILES and W. A. WITMAN, Reading (awarded contract):

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)
7,698 ft. conduit	$9.30	$7.50	$7.78	$7.10	$7.25	$5.29	$5.00	$5.02	$5.06	$4.95	$4.25	$4.00	$4.13	$4.15
82 ft. manholes	4.00	6.00	5.50	2.70	4.00	7.00	5.00	5.00	3.05	2.00	6.80	2.00	3.23	2.65
Intake chamber, complete	2,130.00	3,708.00	3,204.00	2,570.00	1,640.00	3,500.00	4,000.00	4,950.00	1,078.94	2,500.00	3,580.00	2,000.00	1,323.00	937.00
Siphon chamber, complete	1,050.00	974.00	1,715.00	528.00	750.00	1,821.00	3,000.00	1,250.00	961.25	1,080.00	1,700.00	1,000.00	1,213.00	325.00
428 ft. brick pipe	6.00	4.40	3.35	4.30	2.30	4.60	4.00	1.88	1.50	2.00	4.80	3.00	1.13	1.45
64 ft. brick pipe	2.00	3.00	1.25	.93	1.00	1.25	2.00	1.00	.50	1.00	.86	2.00	.73	.80
3,500 bbls. cement	1.50	1.40	1.25	1.71	1.20	1.20	1.50	1.50	1.65	1.35	1.31	1.30	1.33	1.53
300 cu. yds. extra excavation	2.50	2.50	1.00	.75	.70	1.50	1.00	2.50	.78	1.10	1.00	1.50	.73	.90
300 cu. yds. extra concrete	6.00	10.50	7.00	3.60	5.50	5.00	4.50	4.00	8.82	5.00	9.00	5.00	4.93	3.75
Total	$85,595	$73,784	$73,549	$67,165	$65,637	$54,816	$54,640	$53,323	$50,571	$49,324	$48,249	$41,868	$41,479	$40,848

*DAM.—Springfield, Mass.—Bids in detail were received as follows by the Board of Water Commissioners on Dec. 4 for the construction of an earth dam as included under Little River Water Supply, Contract No. 5. E. E. Lochridge is Ch. Engr. Bidders were: (A) Cement Paving & Construction Co., 1 Montgomery St., Jersey City, N. J.; (B) Robt. K. Everett & Co., Tarrytown, N. Y.; (C) Coleman Bros., 15 Court Sq., Boston; (D) Shanley-Morrissey, Inc., 527 Fifth Ave., New York; (E) Pennell, O'Hern & Merritt, Yonkers, N. Y.; (F) F. T. Ley & Co., Inc., Springfield; (G) T. Stewart & Son Co., Newton, Mass.; (H) Pierson Engineering & Construction Co., Bristol, Conn.; (I) Bruno & Petitti, 18 Tremont St., Boston:

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)
10,000 cu. yds. earth excavation	$0.75	$1.00	$0.69	$0.50	$1.00	$1.25	$0.70	$1.00	$0.75
4,000 cu. yds. rock excavation	2.50	2.00	2.00	2.00	1.50	2.50	2.00	3.00	2.00
135,000 cu. yds. rolled embankment	.57	.58	.69	.65	.70	.75	.54	.75	.60
3,000 cu. yds. gravel fill	1.50	1.25	.75	1.50	1.00	1.20	1.75	1.75	1.50
3,000 cu. yds. top soil replaced	.50	.45	.30	1.00	.70	.75	.45	1.00	.50
1,700 cu. yds. concrete masonry	9.00	7.00	9.00	9.00	9.00	12.00	12.50	10.00	10.00
8,000 sq. yds. slope paving	.75	.70	.75	1.00	.75	.75	1.25	1.50	1.00
3,000 lin. ft. stone wall	1.00	1.10	2.00	2.20	.75	1.50	3.50	1.50	1.50
Placing c.-i. pipe, gates, etc.	900.00	500.00	800.00	1,000.00	1,500.00	750.00	540.00	250.00	1,200.00
Gate-house and appurtenances	1,500.00	1,200.00	1,700.00	1,000.00	4,000.00	1,000.00	1,500.00	1,500.00	2,000.00
1,500 lin. ft. macadam roadway	1.00	1.50	1.25	3.50	1.50	2.00	2.00	2.00	3.00
17,000 lin. ft. common roadway	.40	.95	1.00	.60	1.25	.70	1.75	1.50	2.50
Clearing reservoir site	11,000.00	6,000.00	10,000.00	16,000.00	12,500.00	4,000,00	12,000.00	12,000.00	30,000.00
Total	$146,450	$148,300	$169,875	$171,600	$180,650	$181,150	$183,040	$207,350	$212,200

AQUEDUCT.—Los Angeles, Cal.—Bids in detail were received as follows on Nov. 30 by the Board of Public Works for the Antelope Division of the Los Angeles aqueduct. Horace B. Ferris is Secy. Bd. The bidders were (A) Henningsen Construction Co.; (B) P. A. HOWARD, 212 Frost Bldg., Los Angeles (awarded contract); (C) A. C. St. John, 303 H. W. Hellman Bldg., Los Angeles; (D) A. H. Calkins; (E) Engineer's estimate:

	(A)	(B)	(C)	(D)	(E)
1,485 lin. ft. completed and lined tunnel	$37.00	$30.00	$30.00	$23.00	$26.50
280 lin. ft. lining tunnel excavation before contract	23.00	12.00	15.00	11.00	11.50
58,625 lin. ft. canal lining with cover and backfill	10.75	6.20	8.00	7.21	5.69
283,140 cu. yds. excavation	1.00	0.40	0.25	0.46½	0.26½
446 cu. yds. plain concrete in culverts	15.00	8.00	10.00	10.00	12.00
100 cu. yds. rubble concrete	10.00	8.00	10.00	7.00	5.00
Totals	$982,434	$529,009	$593,995	$596,741	$457,350
Added for contractor's equipment					30,000
Total cost to contractor					$487,350
Additional cost to city: 56,871 bbls. of cement at $1.41					80,188
Additional cost to city: 671,484 lbs. reinforcing steel at .03½					23,500
Additional cost to city: 280 lin ft. of tunnel excavated prior to contract.					4,200
Total cost to city					$595,238

Note.—No additions have been made in Engineer's estimate for contingencies or contractor's profit.

MISCELLANEOUS CONTRACTS.

(Continued from page 210.)

WHARF.—Detroit, Mich.—The Detroit Lighting Commission has awarded to the GREAT LAKES DREDGE & DOCK CO., of Cleveland, Ohio, the contract for the construction of a concrete wharf at the plant on Detroit River.

RETAINING WALL.—Sandusky, Ohio.—Bids are asked by the Board of Public Service, until noon, Dec. 12, for the labor and material and for constructing a retaining wall along the south line of Decatur St. Slip. Adam J. Stall is Pres. Bd.

*SEAWALL.—Fort Morgan, Ala.—Bids will be received by Maj. H. Jervey, Corps Engrs., U. S. A., Mobile, until 11 a. m., Dec. 24, for construction of seawall at Fort Morgan. Plans and specifications are on file at office of Engineering News, New York.

*METAL WORK.—Mobile, Ala.—Bids are asked until noon, Jan. 4 by the Light-House Engr., Mobile, Ala., for furnishing materials and labor of all kinds necessary for the construction and delivery of the metal work for Galveston Jetty Light-Station, Tex.

CULVERTS.—Geneseo, Ill.—Bids will be received until Dec. 11 by the Commissioners of Mud Creek Special Drainage District, Henry County, for constructing 28 culverts with head walls. H. E. Reeves, Atkinson, Ill., Engr.; Henry Waterman, of Geneseo, Attorney.

PIER.—New York, N. Y.—Bids are asked until noon, Dec. 17, for Contract No. 1161: For furnishing all the labor and materials required for preparing, for repairing and rebuilding a portion of the West 35th St. pier, known as pier 75, North River, Boro. of Manhattan.

FREIGHT STEAMER.—Hamilton, Ont.—The GREAT LAKES ENGINEERING WORKS, of Detroit, Mich., has secured a contract to build a bulk freight steamer, 500 ft. long, to be added to the Canadian fleet of the Inland Navigation Co., of Hamilton, Ont. The ship is to be delivered next spring.

WHARF, DREDGING.—Norfolk, Va.—Bids were received on Dec. 5 by the Bureau of Yards and Docks, Navy Dept., Washington, for a timber wharf about 350 ft. by 50 ft., and for dredging about 40,000 cu. yds. of mud, etc., at the navy yard, Norfolk, Va. The lowest bids were: Item 1, Wm. L. Miller, 19 Milk St., Boston, Mass., $22,940; Item 4, the Norfolk Dredging Co., 217 Water St., Norfolk, $4,345.

*TUNNEL, SHAFT, ELEVATOR.—Niagara Falls, N. Y.—Bids received by Edward H. Perry, Supt. State Reservation, Niagara Falls, on Dec. 4, for (A) construction complete, including plumbing, electric heating and lighting for shaft and tunnel, and inclined foot path; and (B) for elevators, including machinery, at the State Reservation, have been rejected, as they exceeded funds available. Plans will be revised.

REPAIRING FERRYBOATS.—New York, N. Y.—Bids were received as follows by Allen N. Spooner, Dock Comr., on Dec. 3, for furnishing all the labor and materials required for repairing the municipal ferryboats, or other floating ferry property, and furnishing and delivering supplies therefor: James Shewan & Son, foot Houston St., East River, $53,865; J. W. Sullivan, 827 East Ninth St., $124,425; James Tregarthen Son & Co., foot Seventh St., $129,457; Griscom-Spencer Co., 90 West St., $126,053; Alex. Miller & Bros., Jersey City, $121,950.

DREDGING.—Boston, Mass.—Bids were received by the Board of Harbor and Land Commissioners, Boston, on Dec. 4, for dredging the channel of the South River, Salem. The work to be done is the dredging of about 22,000 cu. yds., scow measurement, of material to make the channel 8 ft. deep at mean low water, from about 200 ft. below Union St. bridge to the westerly boundary of the Salem Electric Lighting Co.'s premises, a distance of about 1,300 ft. The only bidder was John H. Gerrish, 247 Atlantic Ave., Boston, 38.5 cts. per cu. yd. Frank W. Hodgdon, State House, Boston, is Ch. Engr., Mass. Harbor and Land Comn.

DREDGING.—New York, N. Y.—Bids were received on Nov. 20 by Allen N. Spooner, Comr. Docks, for the following work: (a) Contract No. 1141. For furnishing all the labor and materials required for dredging about 25,000 cu. yds. of material in the Boroughs of Manhattan, Brooklyn, Queens, the Bronx and Richmond. And (b) Contract No. 154: For furnishing all the labor and materials required for dredging about 200,000 cu. yds. on the North River. Contracts have been let as follows: (a) R. G. PACKARD CO., 130 Pearl St., 56 cts. cu. yd.; (b) TAYLOR DREDGING CO., 21 State St., 14½ cts. cu. yd.

WATERWAY.—Beaufort, N. C.—Bids were received on Nov. 20 by Capt. Earl I. Brown, Corps Engrs., U. S. A., Wilmington, N. C., for constructing a waterway from Pamlico Sound to Beaufort Inlet and the lowest bid received was that of Crafts & Smith, of Dublin, Ga., at the following bid: 500 cu. yds. excavation, $3.64; 1,500 cu. yds. embankment, 28.6 cts.; 450 bbls. cement, per bbl., $2.28; 450 cu. yds. concrete, $5; 150,000 lbs. iron and steel, 6¾ cts.; 3 M. ft. timber, $80; 1,700 ft. piling, 90 cts.; total, $17,150. They also submitted a bid of $20,885 to include 200,000 lbs. of steel instead of 150,000 lbs. Totals of other bids, including 200,000 lbs. of steel, are as follows: Penn Bridge Co., Washington, D. C., $23,932; Owego Bridge Co., Owego, N. Y., $27,065; Nelson-Meredith Co., Chambersburg, Pa., $23,635; Roanoke Bridge Co., Roanoke, Va., $26,792; Carolina Engineering Co., Burlington, N. C., $26,962 and $26,062; Schwiers & Sutton Co., New York, $26,942; Merrill-Ruchgaber-Fraser Co., New York, $25,245; New Jersey Foundry & Machine Co., New York, $26,780 and $25,755.

U. S. POSSESSIONS AND CUBA.

ICE-MAKING AND REFRIGERATING MACHINERY.—Porto Rico.—The lowest bids received on Nov. 21 by the Bureau of Yards and Docks, Navy Dept., Washington, D. C., for furnishing and installing ice-making and refrigerating machinery at Navy Station, Culebra, Porto Rico, were as follows: Items 1 and 2, the MacKay Engineering Co., Baltimore, $3,545 and $2,475, respectively; Item 3, Remington Machine Co., Wilmington, Del., $4,262; Item 4, Kroeschel Bros. Ice Machine Co., Chicago, $4,378.

CRANES.—Panama.—Bids were received as follows on Dec. 4 at the office of the Isthmian Canal Commission for furnishing three unloader cranes, adapted to handle grab buckets of 2.5 to 3.5 cu. yds. capacity, to be used in unloading barges: Bergen Point Iron Works, 149 Broadway, New York, $53,310, 210 days; Modern Steel Structural Co., Waukesha, Wis., $62,114, 175 days; Morgan Engineering Co., Alliance, Ohio, $83,470, 210 days; Wellman-Seaver-Morgan Engineering Co., Cleveland, Ohio, $86,100, 210 days; J. M. Dodge Co., Philadelphia, $57,390, 150 days; Interstate Engineering Co., Bedford, Ohio, $62,130, 210 days; Cleveland Crane & Engineering Co., Wickliffe, Ohio, $50,622, 205 days.

LOCOMOTIVES.—Panama.—Bids were received as follows on Dec. 7 at the office of the Isthmian Canal Commission, Washington, D. C., for the furnishing of ten narrow-gage oil-burning locomotives, six-wheeler, each capable of hauling loads of 30 tons, saddle-tank, double-end type. Alternate bid is asked on coal-burning locomotives, at a deduction from the original bid: Burnham, Williams & Co., Philadelphia, $33,900; alternate, deduct $400; 90 days. Davenport Locomotive Works, Davenport, Iowa, $32,500; alt., $2,500; $30,500; alt., $1,000; 90 days. Lima Locomotive & Machine Co., Lima, Ohio, $36,-650; $38,000 for 18-ton Shay geared; $48,000 for 38-ton; $32,000 for 13-ton; alt., $2,500; 90 days. H. K. Porter Co., Pittsburg, $32,-250; $29,250; $27,250, on various types; alt., deduct $1,150; 70 to 90 days. Vulcan Iron Works, Wilkes-Barre, Pa., $33,500; alt., $1,-000; 84 days. American Locomotive Co., 30 Church St., New York, $33,000; $30,000; alt., deduct $1,500; 90 days.

CIVIL SERVICE EXAMINATIONS.

INSPECTOR OF BOILERS.—Washington, D. C.—The U. S. Civil Service Commission announces an examination on Jan. 6-7, to secure eligibles from which to make certification to fill a vacancy in the position of Assistant Inspector of Boilers of Steam Vessels, $1,800 a year, in the Steamboat-Inspection Service at New Orleans, La., and vacancies requiring similar qualifications, as they may occur in that service throughout the United States. Age limit, 25 to 55 years. Application Forms 1087 and 1405.

ASSISTANT ENGINEER.—Washington, D. C.—The U. S. Civil Service Commission announces an examination on Jan. 6 to secure eligibles from which to make certification to fill a vacancy in the position of Assistant Engineer of Tests (male), $1,200 a year. Ordnance Department at Large, Watertown Arsenal, Mass., and vacancies requiring similar qualifications as they may occur in any branch of the service. Age limit, 20 years. Application Form 1312. Applications must be filed prior to closing hour on Dec. 26.

ASSISTANT (Bureau of Mines)—Philippines.—The U. S. Civil Service Commission announces that applications will be received for consideration in connection with filling a vacancy in the above-named position in the Philippine Service. Salary, 3,000 pesos ($1,-800 United States money) a year. Applicants must be graduates in science from some standard college or technical school. A thorough fundamental training in Geology, Mineralogy and Mining Engineering is requisite. Age limit, 21 to 40 years. Application Forms 2 and 375. Applications must be filed prior to closing hour on Jan. 4.

DRAFTSMAN.—Washington, D. C.—The U. S. Civil Service Commission announces an examination on Jan. 6-7-8, to secure eligibles from which to make certification to fill a vacancy in the position of Marine Engine Draftsman in the Light-House Board, Department of Commerce and Labor, at $137.50 a month, and vacancies requiring similar qualifications as they may occur in any branch of the service. The employment of this draftsman and of other persons engaged upon marine construction work is dependent upon the amount of such work authorized by Congress, and it is therefore impracticable to state definitely how long the services will be required. The preparation of plans and specifications for vessels heretofore authorized will require service for some months. Age limit, 18 years. Application Form 1312. Applications must be filed prior to closing hour on Dec. 26.

INDUSTRIAL NOTES.

THE BABCOCK & WILCOX COMPANY has purchased from the Rust Boiler Company its patents and plant located at Midland, Pa., and will continue the manufacture, at that point, of the Rust water-tube boiler.

THE RECEIVERS of the Westinghouse Electric & Manufacturing Company and the Securities Investment Company were discharged in the United States Circuit Court at Pittsburg on Dec. 5 by Judge James S. Young and were ordered to turn the properties over to the stockholders. No receivers' accounts are required to be filed.

THE SANDUSKY PORTLAND CEMENT CO., of Sandusky, Ohio, is supplying its white Portland cement for use in the following important contracts: Swift's Engineering Bldg., Northwestern University, Chicago; for exterior stucco finish on the White Garage, San Francisco; for exterior stucco finish on the new Taylor residence at Clairmont Park, Cal.; for pointing Bedford stone on the new Temple Israel, St. Louis; for the House Office Building, Washington, D. C. The same company is supplying Medusa waterproof compound for the following important work: Studebaker private residence at South Bend, Ind.; People's Gas, Light & Coal Co. receiving pit, Chicago; U. S. Navy Yard, Puget Sound, Wash.; Nevada ice and cold storage plant for Southern Pacific Ry. Co.; auditorium swimming tank, St. Louis, Mo.; for cement roofs on planing mill and powerhouse at Wausau, Wis.

TRADE PUBLICATIONS.

CONCRETE WATER TOWER.—Western States Portland Cement Co., Independence, Kan. Paper; 4 × 9 ins.; pp. 8; illustrated.

The water tower of the water company at Anaheim, Cal., built in 1907, has the tower and tank of reinforced-concrete construction, made with "Cowboy" Portland cement. The tower is 112 ft. high, with tank 38 ft. high and 30 ft. diameter.

ENGINEERING AND SURVEYING INSTRUMENTS.—W. & L. E. Gurley, Troy, N. Y. Cloth; 4½ × 6¾ ins.; pp. 470; illustrated; 50 cts.

This is a comprehensive descriptive catalog and price list of a great variety of instruments and appliances for engineers, surveyors and draftsmen. Transits and levels of various ordinary and special designs occupy a large proportion of the book, and are accompanied by information as to their features and their use. The dumpy level, however, is not included, but there are special levels for architects and for drainage work. Plane tables and several forms of surveying compasses (with and without telescopes) are included. Level rods, chains and tapes, hand levels, etc., are all listed and described, and there are different forms of current meters. About 170 pages are occupied by an illustrated price list of drawing instruments and supplies.

PUMPS AND HIGH SPEED ENGINES.—The Blake & Knowles Steam Pump Works, 115 Broadway, New York City. Bulletins B. 815 and 817, K. 813, 814 and 818. Paper; 6 × 9 ins.; illustrated.

One of these bulletins contains illustrations and a brief description of Blake vertical high speed engines, including a table of specifications of engines of from 5 to 270 HP. The remaining bulletins are devoted to Blake & Knowles horizontal and vertical feed and tank pumps and to Knowles vertical sinking pumps for mines. Tables of dimensions and capacities are given.

HEATING AND VENTILATING.—Buffalo Forge Co., Buffalo, N. Y. Catalog No. 197. Paper; 6 × 9 ins.; pp. 143; illustrated.

The preface of this truly valuable addition to trade literature refers to it as "combining the catalog and the treatise," and, in fact, it might well be taken as a text book on the fan system of heating and ventilating. The book is divided into four parts treating respectively public buildings, industrial buildings, apparatus and data. Parts I. and II. are illustrated with views of buildings and sectional elevations and plans showing the arrangement of the fan systems installed. Part III., in describing Buffalo fan system apparatus, includes tables of dimensions, capacities, etc., and detailed illustrations and descriptions of the Carrier air washer and humidifier and of a gas heater to replace the steam coils of the ordinary fan system. An improved form of hygrometer (wet and dry bulb) called a hygrodeik is described. In Part IV., a table of transmission losses through different kinds of walls and flooring is of particular interest. The laws governing the flow of air in pipes and friction in air ducts are discussed.

PIPING AND CHIMNEYS.—The M. W. Kellogg Co., 50 Church St., New York City. Paper; 8½ × 11 ins.; pp. 47; illustrated.

An improved perforated radial brick for chimneys is described. The improvement consists of corrugations on the sides of the bricks which are said to increase the adhesion between brick and mortar 62½%. The greater part of the book is devoted to piping and includes assembled drawings of barometric condensers and drawings of flanges and fittings for large sizes of pipe, with tabulated dimensions. This company makes a specialty of welded nozzles and special bends in wrought iron pipe in sizes around 12 ins.

For other Proposal Advertisements see pages 47, 48, 49, 50, of Advertisements and Construction News page 212.

BUILDING.

Buffalo, N. Y.

Sealed proposals, endorsed "Proposals for Additions to Elmwood Building; Additional Verandas, Wards 3, 4, 5 and 6; Boiler-room Roof Extension; Construction, including heating, plumbing and electric work," at the Buffalo State Hospital, Buffalo, N. Y., will be received by the State Commission in Lunacy, Capitol, Albany, N. Y., up to 3 o'clock P. M. on the 23d day of December, 1908, when they will be opened and read publicly.

Proposals shall be accompanied by a certified check, and the contractor to whom the award is made will be required to furnish surety company's bond all as called for in the specification. The right is reserved to reject any and all bids.

Drawings and specifications may be consulted and blank forms of proposal obtained at the Buffalo State Hospital and at the office of the State Architect. Complete sets of plans and specifications will be furnished to prospective bidders upon reasonable notice to and in the discretion of the State Architect, Franklin B. Ware, Albany, N. Y.

T. E. McGARR, Secretary,
State Commission in Lunacy.

Dated December 4, 1908.

SEWAGE DISPOSAL PLANT.

Oxford, Ohio.

Sealed proposals will be received by the Village Clerk at his office in the Village Hall, up to 12 o'clock M., December 22d, 1908, for the construction of a sewer disposal plant, consisting of a Sedimentation Tank, Filter Beds, Automatic Distributing Machinery and Controlling House.

Plans and specifications can be seen at the office of the Village Clerk or at the office of The Riggs & Sherman Co., Engineers, Toledo, Ohio.

The Village reserves the right to reject any or all bids.

D. P. BEATON,
Village Clerk.

Oxford, Ohio, Dec. 2, 1908.

FORT MONROE, VA., December 2, 1908.—Sealed proposals, in triplicate, will be received until 10 A. M., January 4, 1908, for furnishing and installing two 264-HP., and one 100-HP. boilers, two 250-HP. compound engines, one 250-HP. and one 120-HP. engines, two 150-KW. and one 75-KW. generators; also all steam, exhaust steam, drip and water, suction and discharge connections; one service condenser and gage board, two boiler feed pumps, three composite inspirators, one feed-water heater, one hot well and automatic pump for oil separator. Also for furnishing and installing complete underground system and complete system of street lighting at Fort Monroe, Va. Bids for five different kinds of work must be submitted separately; bidders on proposals must state names of manufacturers supplying material. Information on application. United States reserves the right to accept or reject any or all proposals or any part thereof. ERNEST R. TILTON, Captain & Constructing Q. M.

TREASURY DEPARTMENT, Office of the Supervising Architect, Washington, D. C., December 3, 1908.—Sealed proposals will be received at this office until 3 o'clock p. m., on the 9th day of January, 1909, and then opened, for the construction (complete) of the U. S. Post-Office at Murfreesboro, Tenn., in accordance with the drawings and specification, copies of which may be had at this office or at the office of the Postmaster at Murfreesboro, Tenn., at the discretion of the Supervising Architect. JAMES KNOX TAYLOR, Supervising Architect.

SEALED PROPOSALS will be received at the office of the Light-House Engineer, Mobile, Ala., until 12 o'clock M., Jan. 4, 1909, and then opened, for furnishing materials and labor of all kinds necessary for the construction and delivery of the metal work for Galveston Jetty Light-Station, Texas, in accordance with specifications, copies of which, with blank proposals and other information, may be had upon application to the LIGHT-HOUSE ENGINEER, Mobile, Ala.

Situations Wanted

Mechanical and Electrical Engineers.

TECHNICAL GRADUATE, 7 years detailing, designing, estimating; desires position as assistant in outside construction or sales. "C.," 3558 West 44th, Cleveland, O. 24-2t

Civil Engineers.

YOUNG ENGINEER wants position electric railway construction or steam railroad maintenance and construction. Just completed two years in charge heavy construction interurban electric railway. References. Address "A. A. 24," Engineering News, New York. 24-2t

Draftsmen.

STRUCTURAL STEEL DRAFTSMAN, with good detailing and designing experience, open for engagement. Address "E. A. 24," Engineering News, New York. 24-3t

DRAFTSMAN—Detailing, checking, estimating and designing; 15 years' experience in structural iron for buildings and bridges. Address "C. A. 24," Engineering News, New York. 24-6t

TRACER and junior draftsman; young man with two years' experience in structural iron and steel, concrete, brick and timber construction, sewage disposal, and handling machinery. Address "A. 23," Engineering News, New York. 24-1t

DRAFTSMAN, mechanical; graduate technical college; 8 years' experience shop and office, designing and estimating; A1 references. Address "B. A. 24," Engineering News, New York. 24-1t

Superintendents, Misc., etc.

DRAFTSMAN and architectural engineer, long experience in building work, steel construction and civil engineering, expert estimator and detailer, open for engagement with architectural firm, contractor or civil engineer. Address "D. A. 24," Engineering News, New York. 24-2t

GRADUATE, U. S. NAVAL ACADEMY, experience mechanical engineering, first-class draftsman, desires position. Address "F. A. 24," Engineering News, New York. 24-1t

TECHNICAL GRADUATE, 4 years' experience in field and office on sanitary, road and survey work, desires position with water-works company or city engineer. Address "X. A. 24," Engineering News, New York. 24-3t

DREDGING SUPERINTENDENT; nine years' coast and canal experience. Familiar with clam shell, dipper and hydraulic types. At present employed. Best references. Address "H. 23," Engineering News, New York. 24-2t

Situations Open

WANTED AT ONCE—Thoroughly experienced engineer for reinforced-concrete work; applicant must be able to take charge of a few men, take off quantities, make simple designs and check shop drawings for a built-up system. References and salary desired and how soon could report for work. Address ENGINEERING DEPARTMENT, Cummings Structural Concrete Co., 916 Fourth Ave., Pittsburg, Pa. 24-1t

Miscellaneous Wants

AGENCY WANTED—Engineer about to open a Boston office would like to represent any first-class firm as sales agent. Address "G. A. 24," Engineering News, New York. 24-3t

BUSINESS OPPORTUNITY WANTED, by young civil engineer, college and university graduate, to invest some capital, and to take an active interest in contracting business, or similar enterprise, in which engineering training would be of value; in or near New York. Only parties with first-class references and willing to stand rigid investigation need reply. Address "Z. A. 24," Engineering News, New York. 24-2t

CONTRACTOR'S CIVIL ENGINEER wants to associate himself with party having similar experience, for purpose of going into contracting business. Only parties who are prepared to furnish capital, as he is, need answer. Address "H. A. 24," Engineering News, New York. 24-3t

MANUFACTURERS' REPRESENTATIVE.—Competent, experienced, 20 years' personal business acquaintance with architects and engineers, invites correspondence relative to manufacturers' representation in Pittsburg and vicinity. Best references. Address F. G. STIEREN, 3406 Fifth Ave., Pittsburg, Pa. 24-1t

CONTRACTOR

with fifty horses wants sub-contract for earth work or hauling of any kind until April 1st. Will ship anywhere. B. CARPENTER, R. F. D., Round Lake, Illinois. 24-2t

FOR SALE

FOR SALE.

20" × 42" IMPROVED GREENE ENGINE. Wheel 32" × 14 ft. Used seven years. Also 24" × 48" IMPROVED GREENE ENGINE. Wheel 42" × 16 ft. Used eight years. Both engines in first-class shape. Can be seen running. THE CAPEWELL HORSE NAIL CO., Hartford, Conn. 24-4t

FOR SALE.

One New Monarch Steam Roller

Just as received from factory. Large discount allowed from price paid.

Address "N. E. M.," Engineering News, New York City.

FOR SALE

MODERN BRIDGE PLANT AND EQUIPMENT

There will be offered for sale at the plant of the Southwestern Bridge Company, bankrupt, Joplin, Missouri, on December 22, 1908, at one o'clock p. m., all of the real estate, buildings, furniture, material, tools and equipment of the above concern, including approximately four acres, located on the St. Louis & San Francisco Railroad, office building, machine shop and steel structural shop; also approximately 2,250 tons of steel plate, bars and structural steel, and the following tools and equipment:

1 12-in. Punch, capacity ⅝-in. in ⅝-in.
1 36-in. Punch, capacity ⅝-in. in ⅝-in.
1 double 12-in. and 24-in. Punch, capacity ⅝-in. in ⅝-in.
1 12-in. Punch, capacity 1-in. in 1-in.
1 60-in. Punch, capacity 2-in. in 1-in.
1 36-in. Punch, capacity 2-in. in 1-in.
1 6-in. Punch, capacity ½-in. in ½-in.
1 Horizontal Punch, 8-in. throat, capacity ⅝-in. in ⅝-in.
1 Double Angle Shear, capacity 6 × 6 × 1-in. angles.
1 Bending and Straightening Machine.
1 Q. & C. Cold Saw, with extra milling head.
1 1,500-pound Steam Hammer.
1 50-in. Head Rotary Planer.
1 18 × 11 × 12-in. Duplex Air Compressor.
1 Wall Radial Drill, 20-in., arm.
1 Hendey 20-in. Shaper.
1 Ryerson Friction Saw, 500 volt D. C. motor.
1 Hendey 16-in. Lathe.
1 2-in. Reliance Bolt Cutter.
1 1½-in. National Bolt Cutter.
1 set special 8-in. Bending Rolls, 11-in. and 8-in. rolls.
1 4-in. Rotary Shear, capacity ⅝-in., plate.
1 National 1-in. Rivet Machine.

Also a large number of miscellaneous tools, including pneumatic riveters, 500-volt direct-current motors, bulldozer, grinders, woodworking machinery, furnaces, scales, boilers, hoists, trolleys, forges and the additional hand and power tools used in a modern bridge shop.

For further information, address:

W. B. KANE, Trustee
Joplin, Missouri. 24-1t

FOR SALE CHEAP

Continuous Mixer

Dump Cars and other Material

New and Old Equipment

Bought and Sold 24-2t

WALSH'S SONS & CO., Newark, N. J.

DERRICK

FOR SALE.

with traveler, boom 18 × 18 × 75 feet long, excellent order, ready for erection. Bargain. Owner, GEO. E. LOVETT, 22 Court St., Brooklyn. 24-1t

BOILER SHOP AND FOUNDRY

For sale at a bargain. A first-class modern boiler shop, foundry and machine shop, equipped with electric traveling cranes, electric motor-driven machinery. Located in the heart of Pittsburg-Cleveland district. Quick buyer gets benefit of established business. Inquiries for work are being received daily. Responsible parties can probably buy subject to existing bonds, which will aid in financing. Address WADE A. TAYLOR, Receiver, The Niles Boiler Co., Niles, Ohio.

FOR SALE.

SECOND-HAND BLUE PRINTING MACHINES

Practically as good as new.

1 Wagenhorst, Style B; Capacity, 2 Prints; 42 × 60.

1 Wagenhorst, Style A; Capacity, 2 Prints; 42 × 72. Also other second-hand outfits and "Everything for Blue Printing."

C. F. PEASE BLUE PRINT MACHINERY AND SUPPLY CO.
22 Fifth Ave., Chicago. 24-2t

FOR SALE

Steam Engines, Steam Pipes, Fittings and other Steam Equipment, Arc Lamps, Dynamos, Switchboards and Belting.

Sealed proposals will be received by the West Chicago Park Commissioners, Union Park, Chicago, on or before 4 o'clock P. M., December 22, 1908, for:

2—650-HP. Cross Compound Corliss Engines, complete, built by Filer & Stowell Mfg. Co.

Also steam pump, Nordberg surface condenser, jack shaft and friction clutches.

1—General Electric Company Alternating Current Dynamo, type A. S. No. 1033. Class 8-90-900. Form A, Amp. 39, Volts 2080-2300. Speed, 900.

Also exciter, switchboard panel, belt, voltmeter and ammeter.

4—General Electric Company Arc Light Dynamos. Type 13A., 8,000 Volts, 9.6 Amp. Speed, 500. Oil regulators, base frames and tighteners.

2—Western Electric Company Arc Light Dynamos. Volts, 7,500, 9.6 Amp. Speed, 600. 2 iron pulleys 33¾" diameter, 13" face. Base frames and tighteners.

Also switchboards, ammeters and belts.

Approximately 800 Standard Boulevard type series open arc focusing lamps, 9.6 Amp. ⅝" × 14" top carbon, ½" × 12" lower carbon. Opal and alabaster globes, 4¾" bottom and 8" opening.

Approximately 100 Thompson-Houston double carbon series open arc lamps 9.6 Amp.

Bids must be made upon forms which may be obtained from the Secretary of the West Chicago Park Commissioners, said forms giving more detailed and complete information.

A deposit of five (5%) per cent. of the total amount of the proposal must be made with each bid, and the West Chicago Park Commissioners reserve the right to reject any or all bids.

GEORGE A. MUGLER
Secretary
West Chicago Park Commissioners
24-1t Union Park, Chicago.